M4RTU/M4 I/O
USER'S GUIDE

Form 676-020322 — March, 2002

OPTO 22

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M4RTU/M4 I/O User's Guide
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WELCOME

ABOUT THE M4RTU/M4 I/O

Thank you for purchasing an Opto 22 Modular M4RTU or M4 I/O Controller. The M4RTU/M4 I/O delivers the functionality and robustness of a remote telemetry unit with the power of a distributed automation system, all in one controller. The M4RTU/M4 I/O consolidates two powerful processors on a single processor board. Program control and host communications are handled by a powerful 32-bit microprocessor, while another processor handles I/O interfacing and control. This dual-processor board is combined with a digital/analog I/O board, a 3-slot vertical expansion bus board (M4BUS), and a modular power supply into a compact aluminum extrusion package that can be mounted horizontally or vertically. A complete line of modular adapter cards are available, providing a wide range of communication options.

ABOUT THIS MANUAL

This reference manual provides complete specifications and instructions to set up and install a M4RTU or M4 I/O controller.

In this manual you'll find:

- **Chapter 1: Introduction** — General information about the M4RTU/M4 I/O, its possible applications, basic architecture, and hardware diagrams.
- **Chapter 2: Quick Start** — A brief explanation of how to quickly get the M4RTU/M4 I/O up and running.
- **Chapter 3: Installation and Setup** — Descriptions of jumper settings, communication connections, and installation procedures.
- **Chapter 4: Software and Firmware** — General software and firmware overviews and communication procedures.
- **Chapter 5: Field Wiring** — Detailed information on digital and analog field wiring, including examples.
- **Appendix A: Troubleshooting** — Tips for resolving problems you may encounter.
- **Appendix B: Cable and Connector Specifications** — A list of recommended communication cables and connectors.

- **Appendix C: Product Specifications** — A list of specifications for the M4RTU/M4 I/O.
- **Appendix D: Address Jumper Configuration** — Jumper settings for all addresses.
- **Appendix E: Upgrading RAM and Flash EEPROM** — Instructions for replacing RAM and Flash EEPROM upgrade chips.
- **Appendix F: Worksheets:** — Worksheets that can be used to plan field wiring installation and power consumption.
- **Appendix G: Product Support:** — Details on how to reach Opto 22's Product Support team.

INTRODUCTION

OVERVIEW – M4RTU/M4 I/O REMOTE TELEMETRY UNIT

The M4RTU/M4 I/O combines the features and functions of a Remote Telemetry Unit (RTU) with the power of a distributed automation system all in a single controller. The M4RTU/M4 I/O is the heart of Opto 22's distributed control hardware platform. This advanced hardware/software solution is built to be deployed in any type of network or remote control environment. The M4RTU/M4 I/O was designed specifically for industrial field applications, such as wastewater treatment, well monitoring, tank farms, substation automation, and gas/petrochemical applications.

The M4RTU/M4 I/O is fully supported with FactoryFloor, Opto 22's suite of Windows™ 32-bit software that delivers total control to industrial automation customers. FactoryFloor consists of four integrated components:

- OptoControl™, a graphical, flowchart-based development environment for control solutions.
- OptoDisplay™, a graphical, multimedia operator interface package.
- OptoServer™, a robust data server that connects the controller network with the PC-based FactoryFloor network.
- Plus OptoConnect™, a drag-and-drop database utility that makes building SQL Server and Access databases a snap.

The M4RTU/M4 I/O is part of Opto 22's Modular line of controllers. These units feature a powerful, yet easy-to-use modular design that incorporates Opto 22's M4 bus technology (M4BUS). This technology lets customers tailor their controller and interface hardware to the scale of the project at hand. The M4BUS allows users to create custom interface configurations by simply plugging in one or more of the modular interface cards. These open options allow customers to share real-time plant floor data with telemetry or network-based control and information systems. All modular interface cards for serial communications or network connectivity are supported as standard selections in the FactoryFloor software.

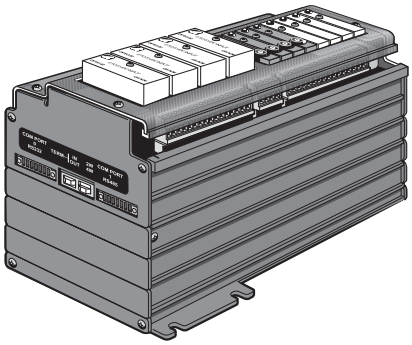


Figure 1-1: M4RTU/M4 I/O Base Unit

The M4RTU/M4 I/O consolidates two powerful processors on a single processor board. Program control and host communications are handled by a powerful 32-bit 68020 microprocessor, while a 16-bit 80C196 processor handles I/O interfacing and control. This dual-processor board is combined with a digital/analog I/O board, a 3-slot vertical expansion bus board (M4BUS), and a modular power supply into a compact aluminum extrusion package that can be mounted horizontally or vertically.

The M4RTU/M4 I/O base unit has two serial ports: RS-232 and RS-485/422. The RS-485/422 port can be used to support I/O expansion using standard Opto 22 digital or analog I/O units. These serial ports can communicate at up to 115 K baud, and the RS-485/422 port logically supports up to 4,096 remote I/O channels as a remote bus.

The M4RTU/M4 I/O comes standard with 1 MB of battery-backed RAM and 256 KB of flash memory. The RAM can be used to store a user's control strategy (program) and data. The flash memory stores a kernel (operating system) and can be used to store a user's control strategy permanently. The use of flash technology throughout the M4RTU/M4 I/O allows the user to remotely download new kernels offered by Opto 22. This avoids the need to visit an M4RTU/M4 I/O site to download a new kernel that offers features required for a given application.

The M4RTU/M4 I/O base unit accommodates a total of eight digital and four analog Generation 4® (G4) I/O modules. The G4 digital I/O modules provide optical isolation, come in a variety of DC and AC voltages, feature an integral status LED as well as fused outputs, and offer an optional integral automatic/manual diagnostic switch. The G4 analog I/O modules provide both optical and transformer isolation, eliminating ground loops and channel-to-channel interference. Analog modules come in a variety of field input and output types, including current loop, voltage, thermocouple, RTD, ICTD, and TPOs. Analog current modules include the option to power the current loop, eliminating costly power supplies and wiring.

For safety and convenience, the M4RTU/M4 I/O has system monitors for temperature, AC operation, and low battery, and includes such features as a real-time clock and watchdog timers. Removable connector technology is integrated throughout the unit for easy maintenance and wiring removal. Expansion options are available for adding I/O channels as well as for communicating with SCADA systems, industrial PCs, other controllers or intelligent equipment devices.

Available Options

The M4RTU/M4 I/O accommodates eight digital and four analog G4 I/O modules. For applications requiring additional I/O modules, the Modular Controller product line includes a Modular Controller I/O Extender, called the M4RTUX, which connects to the M4RTU/M4 I/O base unit using an Opto 22 shielded 25-pin M4RTUXCAB cable. The M4RTUX provides an additional eight digital and four analog I/O channels. With the M4RTUX option connected to the M4RTU/M4 I/O base unit, up to 24 G4 I/O modules can be installed. Additional I/O can be connected via an RS-485 serial link.

To accommodate a wide variety of applications, seven power supplies are available for the M4RTU/M4 I/O: four wide-input-range DC (12V, 24V, 48V, 125V), two wide-input-range AC (120V, 220V), and one line filter base for connecting user-supplied power supplies. These fuse-protected power supplies feature input-to-output isolation protection, a built-in EMI filter, and an on/off switch. They supply enough power to operate the M4RTU/M4 I/O base unit, three M4BUS expansion options, and I/O modules for both the base unit and the Modular M4 Controller I/O Extender. They can also supply the current loop for analog current modules.

The M4BUS technology provides a variety of communication interface cards. M4RTU/M4 I/O options include Ethernet interface cards (M4SENETU and M4SENETC), an ARCNET® interface card (M4SARC), a serial (RS-232 and RS-422/RS-485) interface card (M4SSER), a fiber optic ARCNET®card (M4SARCF) and a fiber optic ARCNET® repeater card (M4SARCFR). These open options allow customers to share real-time data with telemetry-based SCADA systems or network-based control and information systems. The available serial ports communicate at up to 115 K baud. These ports can be used to support additional I/O units, perform host communications, interface to a modem or transmit data to and from third-party devices. The Ethernet and ARCNET options enable you to connect the M4RTU/M4 I/O to other major system components using plantwide information networks. All modular interface cards for serial communications or network connectivity are supported as standard selections in the FactoryFloor software.

Software

M4RTU/M4 I/O configuration and program development are performed on a PC workstation through OptoControl, Opto 22's PC-based graphical, flowchart language. OptoControl is easy to learn, easy to use, and is designed to harness all the power of Opto 22's distributed, control hardware platform. One of the fundamental advantages of OptoControl is its usability. Six months after you write an OptoControl program, you can come back to it and understand it. Four key features of OptoControl are:

- OptoControl's flowchart programming environment, which provides a precise, graphical view of your control process.
- OptoControl's "Strategy Tree," which provides a graphical tree-like view of your control system configuration.
- OptoControl's animated debugger, which makes it easy to step through your process and see what's happening at every point in your control program.
- OptoControl flowcharts, which can be packaged as subroutines to provide extensive code reusability.

All these tools can be live on your workstation at the same time, thanks to Window's multitasking. This self-documenting control environment is further enhanced by the use of a plain English command set, and a long tagname database that is shared by all FactoryFloor components.

During development of your application, you can download your control strategy to the M4RTU/M4 I/O and debug the program using the OptoControl debug mode. OptoDisplay, Opto 22's operator interface package, uses the long tagname database generated by OptoControl to easily develop a graphical display of your process.

OptoControl's built-in Software Developers Kit (SDK) allows custom software developers a direct interface to Opto 22 controllers from high level programming languages. OptoControl also provides open access to the database for third-parties and custom developers through the use of OptoServer, and the communications-enabling technologies inherent in Windows. Using OptoServer, the data server that connects the controller network with the PC-based FactoryFloor network, you can develop client/server architectures supporting any DDE or OPC aware third-party applications.

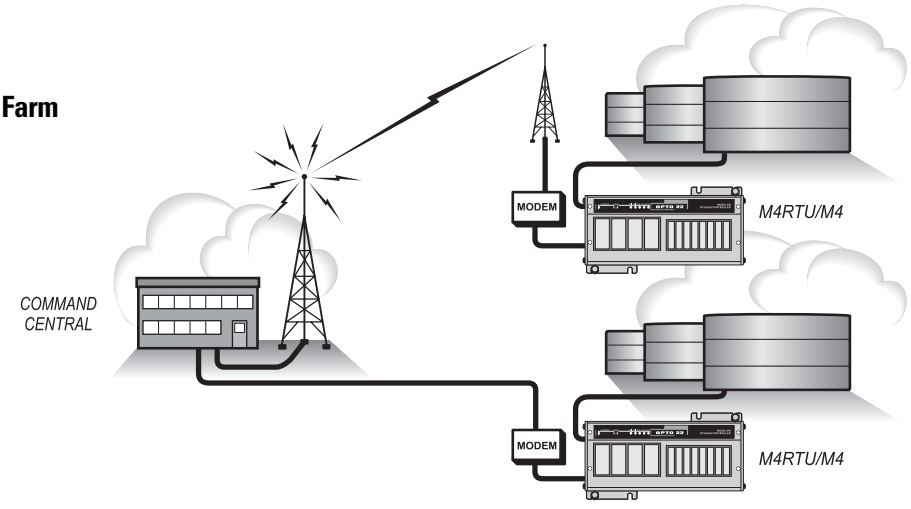
The FactoryFloor software environment supports modems (direct, lease, and radio), two-way dial-up capability (host to M4RTU/M4 I/O, M4RTU/M4 I/O to host), and peer-to-peer communications. It also supports remote kernel downloading to flash memory, remote program downloading and debugging, and remote data uploading and downloading.

POSSIBLE APPLICATIONS

Flexibility is a key feature of Opto 22's Modular controllers. This flexibility enables the M4RTU/M4 I/O to be used in a wide range of applications, including SCADA, remote, distributive, stand alone, process control, tooling, communication, data acquisition, and OEM applications.

The following diagrams depict two common applications for the M4RTU/M4 I/O: a tank farm and a remote plant management system. Both applications typically require process control and data acquisition to be performed remotely.

Tank Farm



Remote Plant Management

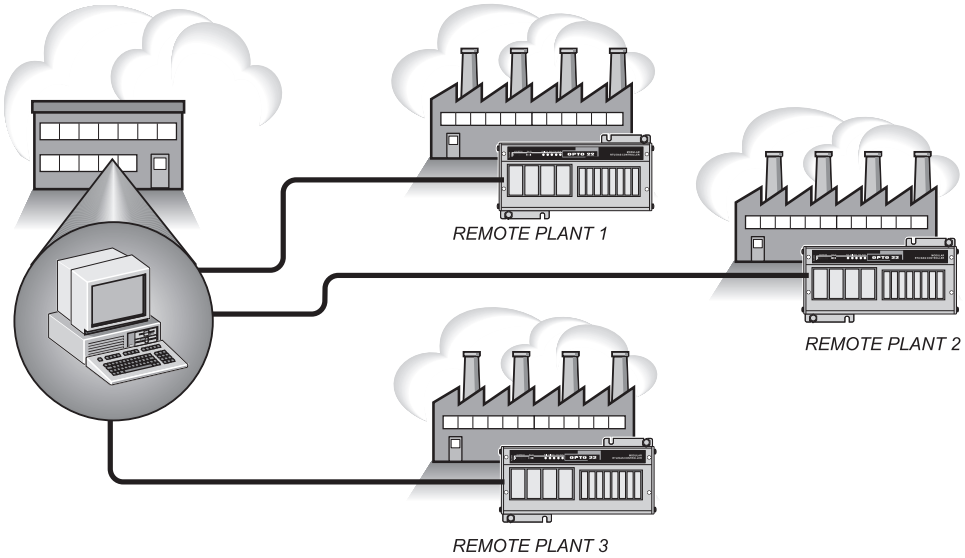


Figure 1-2: Examples of M4RTU/M4 I/O Applications

The M4RTU/M4 I/O is designed to be easy to configure in a variety of communication configurations, including modems connected to standard telephone lines, leased lines, radio frequency transceivers, and direct serial connections to PC hardware.

The design of the M4RTU/M4 I/O is also conducive to integration with Opto 22's digital and analog I/O systems as well as with other intelligent equipment devices, such as industrial PCs, additional M4RTUs or other Opto 22 controllers, subsystem automation gear, wastewater equipment, and various gas/petrochemical devices. See Figures 1-4 and 1-5.

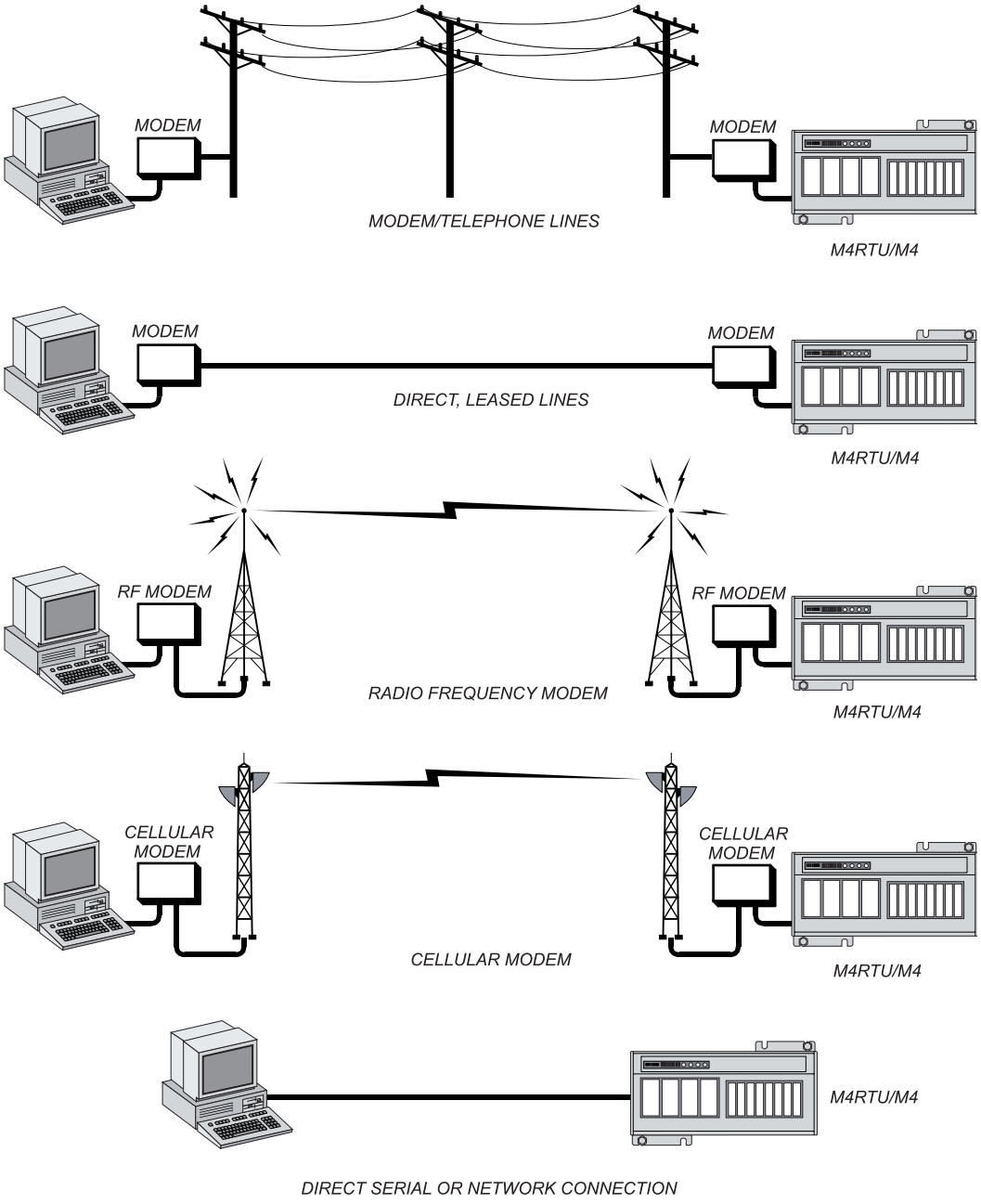


Figure 1-3: M4RTU/M4 I/O Communications Configurations

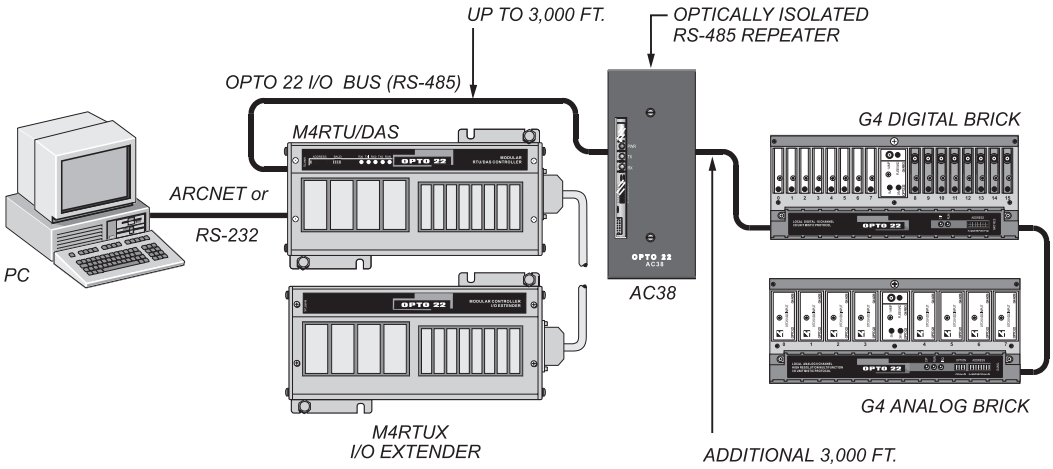


Figure 1-4: Integration of M4RTU/M4 I/O with Expanded I/O

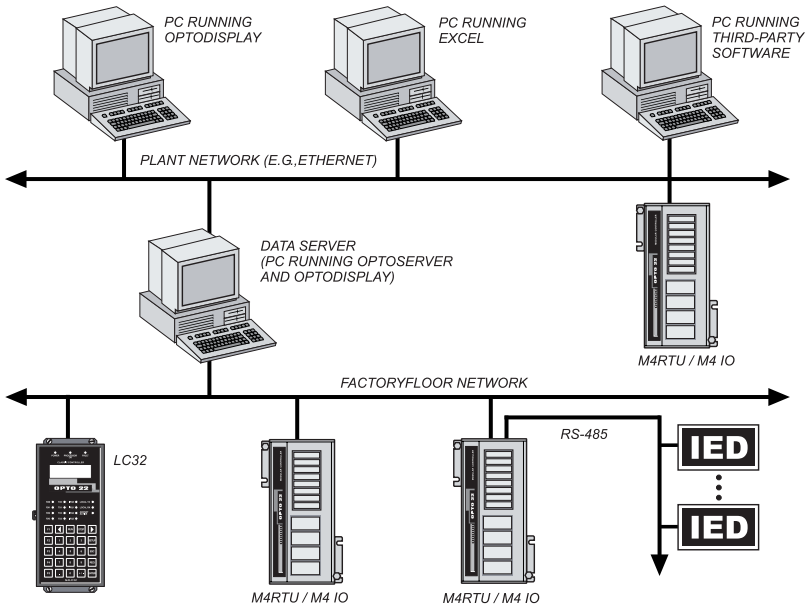


Figure 1-5: Integration of M4RTU/M4 I/O with Other Devices

BASIC ARCHITECTURE

The M4RTU/M4 I/O consolidates two powerful processors on a single processor board. Program control and host communications are handled by a powerful 32-bit 68020 microprocessor, while a 16-bit 80C 196 processor handles I/O interfacing and control. This dual-processor board is combined with a digital/analog I/O board, a 3-slot vertical expansion bus board (M4BUS), and a modular power supply into a compact aluminum extrusion package that can be mounted horizontally or vertically.

A block diagram of the M4RTU/M4 I/O is shown in Figure 1-6.

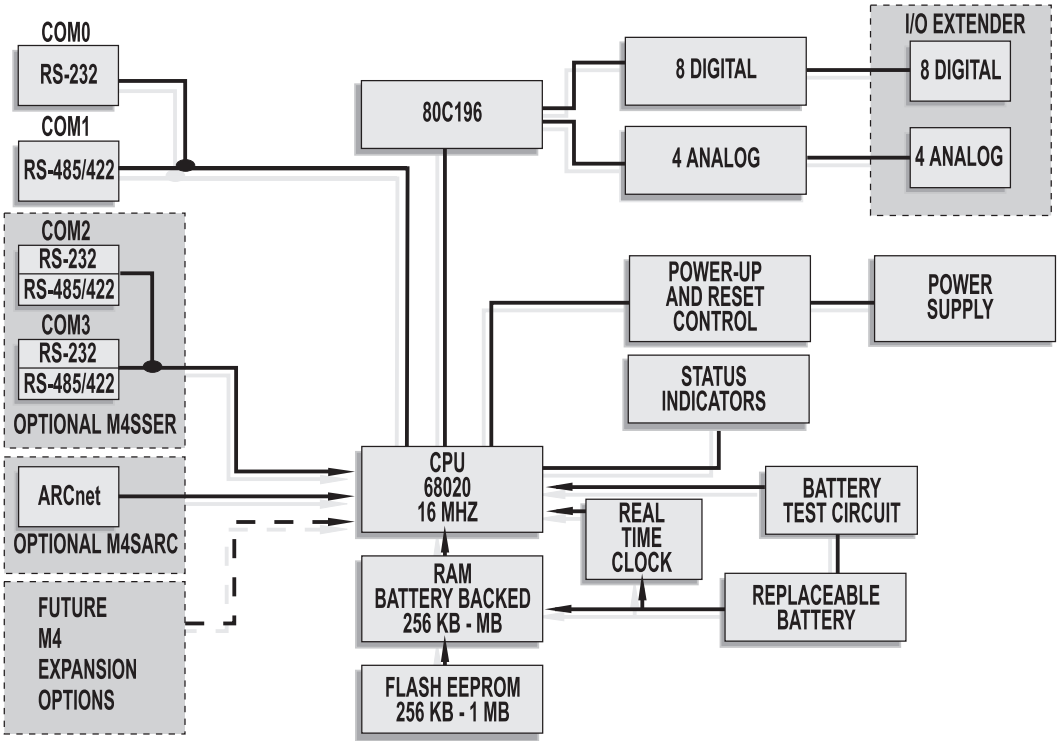


Figure 1-6: Block Diagram of M4RTU/M4 I/O

The powerful two-processor architecture allows the main processor to off-load onto the I/O processor such tasks as counting, frequency and pulse measurement, latching, totalizing, time proportional output control, pulse generation, linearization, ramping, engineering unit conversion, averaging, peak and valley measurement, PID control, and event/reactions, to name a few. I/O control can continue even if the main processor fails or needs to be reset.

Sophisticated reset circuitry and watchdog timer capability permit a user to develop intelligent, robust error recovery.

Finally, the M4BUS lays the foundation for intelligent coprocessor daughter cards. Armed with a processor, these daughter cards have the capability to interface to various industry hardware and software protocols without degrading overall real-time performance.

HARDWARE DIAGRAMS

M4RTU/M4 I/O Base Unit Overview

Figure 1-7 shows the basic components of the M4RTU/M4 I/O as viewed from the end of the unit with the expansion slot and serial connector.

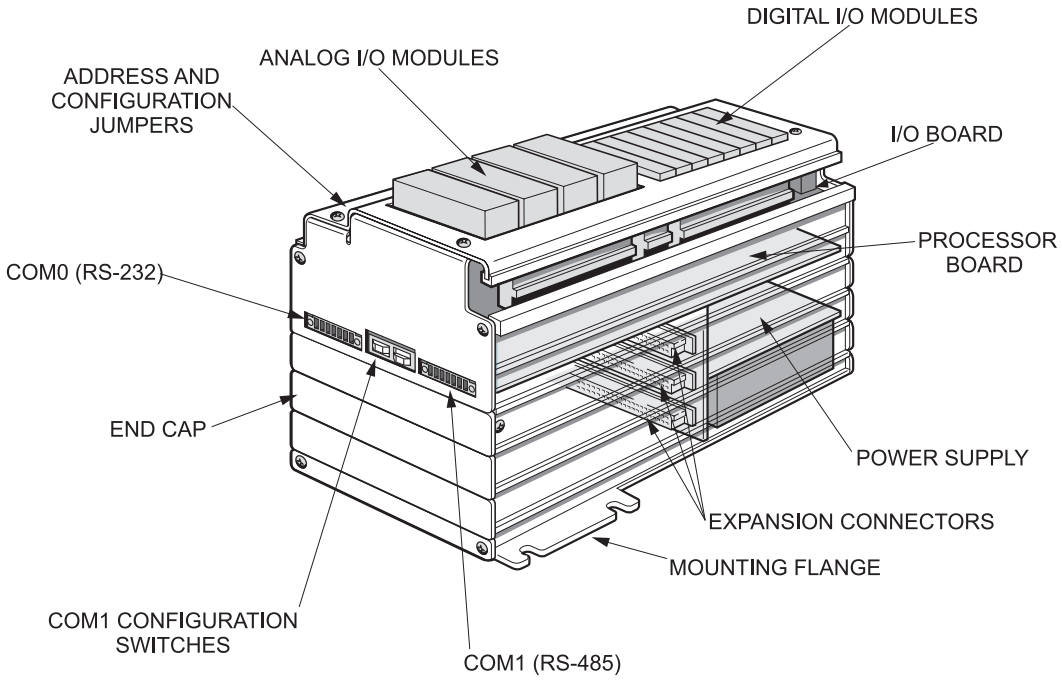


Figure1-7: M4RTU/M4 I/O as Viewed from End with Expansion Slot and Serial Connector

Figure 1-8 shows the basic components of the M4RTU/M4 I/O as viewed from the end of the unit with the power supply and M4RTUX expansion connector.

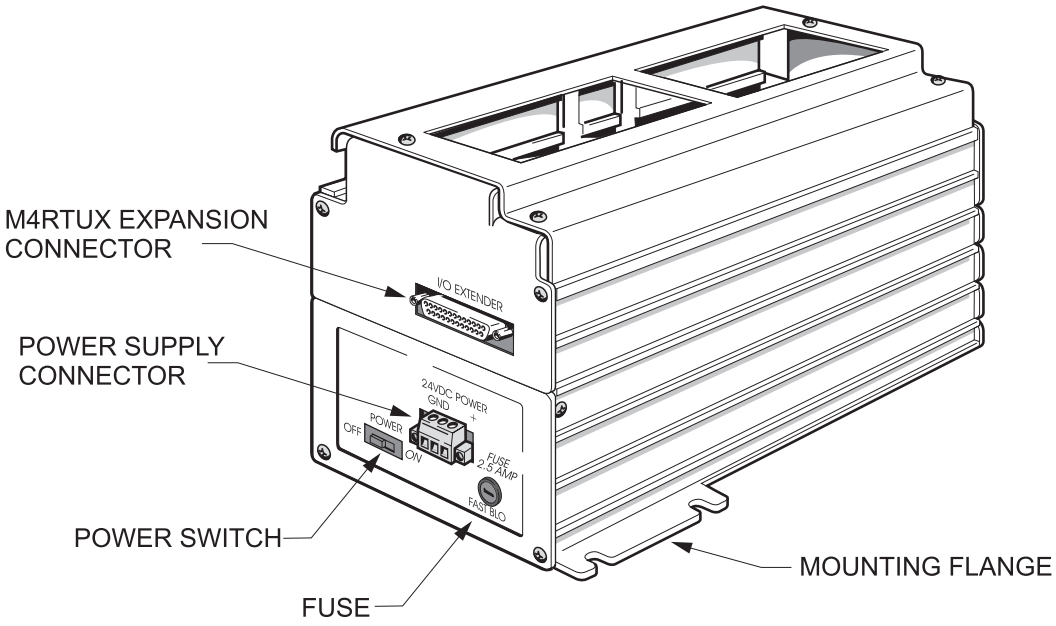


Figure 1-8: M4RTU/M4 I/O as Viewed from End with Power Supply and M4RTUX Connectors

CHAPTER 2

QUICK START

OVERVIEW

This chapter provides a brief explanation of how to get the M4RTU/M4 I/O up and running. You may need to refer to the *OptoControl User's Guide* for detailed instructions. Also refer to appropriate chapters in this manual for field wiring and communication setup instructions and diagrams.

A quick start installation consists of the following steps:

1. Unpacking the M4RTU/M4 I/O and power supply.
2. Installing the power supply.
3. Connecting the battery.
4. Checking configuration jumpers.
5. Installing optional expansion daughter cards and/or connecting cable to the I/O extender, as needed.
6. Mounting the M4RTU/M4 I/O.
7. Connecting to a host PC.
8. Verifying communications.

PACKING LIST

When removing the M4RTU/M4 I/O from its packaging, make sure the M4RTU/M4 I/O and the following components are included:

Component:	Use:
• A bag of extra jumpers	Can be installed as M4RTU/M4 I/O configuration jumpers
• Two RS-485/RS-232 7-position connectors	Connect wiring to serial ports
• Connector key disk, containing six connector keys	Prevents non-keyed connectors from plugging into the serial port
• Mounting template	Serves as a guide for preparing a mounting site for the M4RTU/M4 I/O
• Floppy disk (P/N 8886)	Contains OptoControl firmware
• 2-Floppy disks (P/N 8848)	Contains OptoUtilities, 32-bit utility used to download OptoControl firmware
• Floppy disk (P/N 8887)	Contains Cyrano firmware and DOS-utility to download firmware
• Customer update sheet	Contains latest product information

Note: *If any of the above items is missing or damaged, contact Opto 22 immediately at 1-800-321-6786.*

The M4RTU/M4 I/O requires a power supply, packaged separately. Table 2-1 displays the input power specifications of the seven power supplies currently available.

Table 2-1: M4BUS Power Supplies and Input Voltage Ranges

M4PS12D	12 VDC input (9-15 V)
M4PS24D	24 VDC input (18-30 V)
M4PS48D	48 VDC input (36-60 V)
M4PS125D	125 VDC input (94-156 V)
M4PS120A	120 VAC input (95-130 V)
M4PS240A	240 VAC input (190-250 V)
M4PSF	Line Filter - requires 24 VDC and 5 VDC

INSTALLING THE POWER SUPPLY

1. Place the M4RTU/M4 I/O on a flat surface with the top cover containing the I/O module connectors facing up, and orient the M4RTU/M4 I/O as shown below.

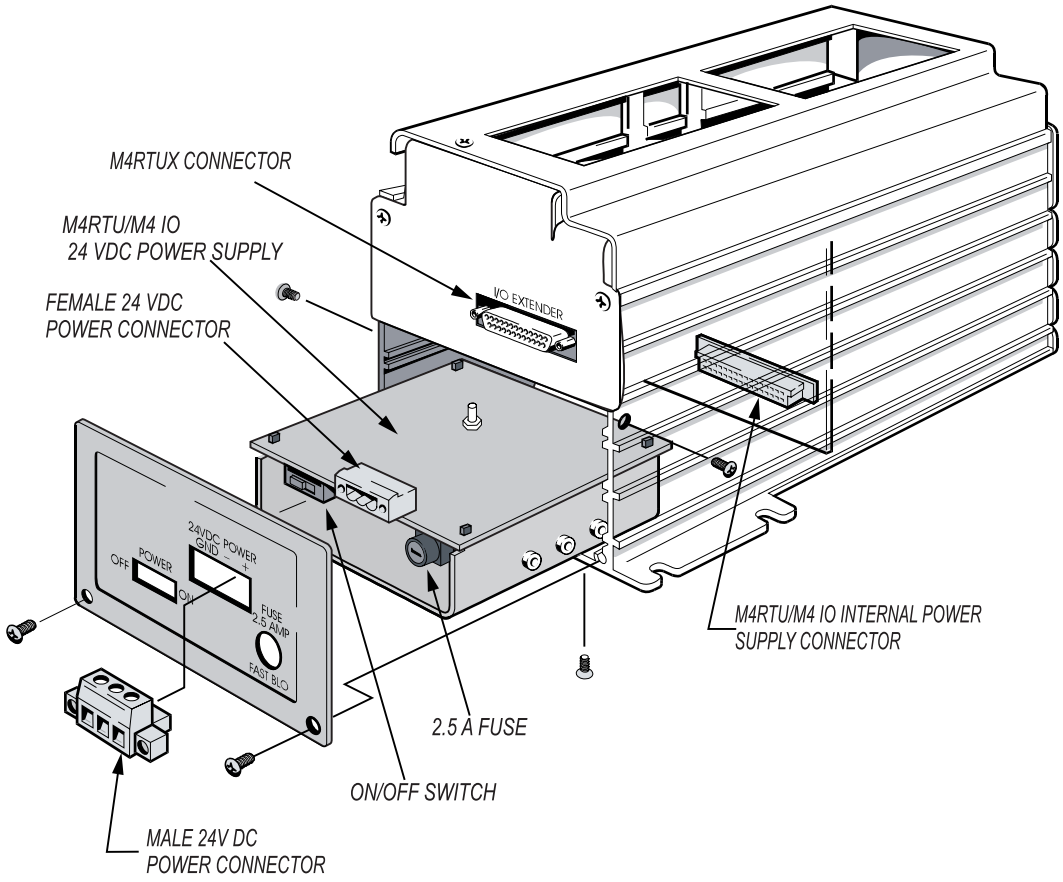


Figure 2-1: Installation of a 24 VDC Power Supply into the M4RTU/M4 I/O

2. Unplug the removable power connector from the power supply. Slide the power supply into the cavity of the M4RTU/M4 I/O until it seats completely.
3. Use the four screws provided to fasten the power supply from the underside of the M4RTU/M4 I/O.
4. Secure the power supply end cap to the end of the M4RTU/M4 I/O using the four screws provided.
5. Connect input wiring as shown in Figure 2-2 (on the following page). Polarity is also shown on the power supply end cap.

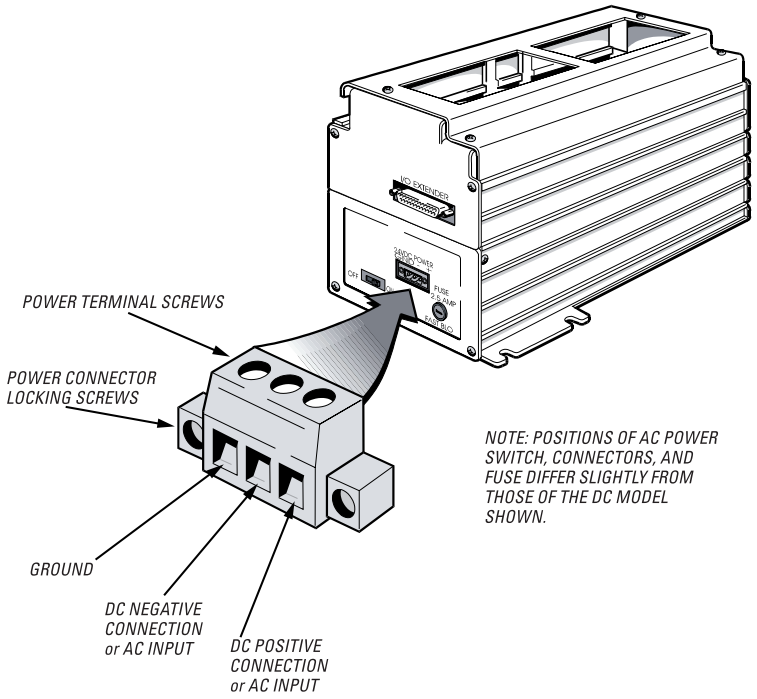

POWER TERMINAL SCREWS
POWER CONNECTOR LOCKING SCREWS
GROUND
DC NEGATIVE CONNECTION or AC INPUT
DC POSITIVE CONNECTION or AC INPUT
NOTE: POSITIONS OF AC POWER SWITCH, CONNECTORS, AND FUSE DIFFER SLIGHTLY FROM THOSE OF THE DC MODEL SHOWN.

Figure 2-2: VDC or VAC Power Connections on the M4RTU/M4 I/O

CONNECTING THE BATTERY

To save battery power, the M4RTU/M4 I/O backup battery is not connected at the factory. You will need to connect it yourself. Refer to Figure 2-3 below to determine the location of the battery and its connection. For detailed information on connecting the battery, see Chapter 3.

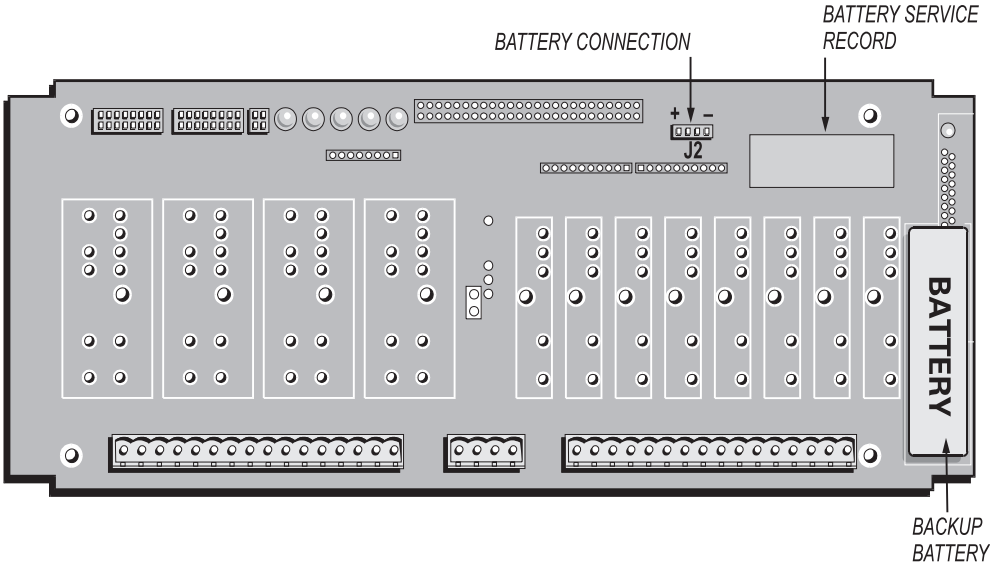


Figure 2-3: Location of Backup Battery on M4RTU/M4 I/O

CHECKING CONFIGURATION JUMPERS

The M4RTU/M4 I/O configuration jumpers are already configured by the factory for connection to a host PC using the M4RTU's COM0 RS-232 serial port, set at a baud rate of 38.4 Kbps. The M4RTU/M4 I/O's default address is 1and the default communication mode is binary. Refer to the figure below for the default configuration of all jumpers.

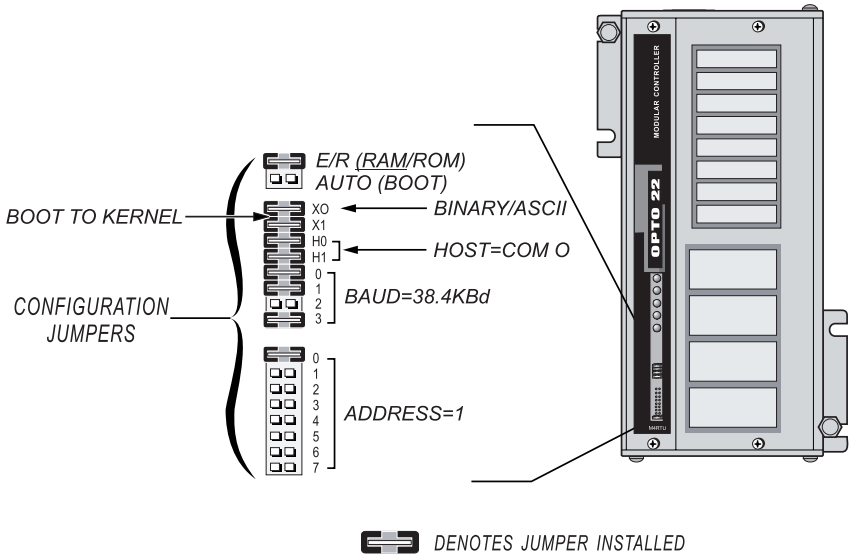


Figure 2-4: M4RTU/M4 I/O Configuration Jumpers

For a complete explanation of all configuration jumpers and switches, see "Setting Configuration Jumpers and Switches" in Chapter 3. For a chart of address jumper configurations, see Appendix D.

INSTALLING DAUGHTER CARDS AND/OR I/O EXTENDER

If you have purchased optional expansion daughter cards for the M4RTU/M4 I/O, you will now need to install them. Refer to the appropriate document listed below for detailed installation instructions:

- M4SSER — see M4 Serial Adapter Card Data Sheet (form 664)
- M4SARC — see M4 ARCNET Adapter Data Sheet (form 631)
- M4SARCF/M4SARCFR — see M4 ARCNET Adapter Fiber Optic Data Sheet and M4 ARCNET Repeater Fiber Optic Data Sheet (form 673)
- M4SENETU/M4SENETC — see M4SENETC and M4SENETU Data Sheet (form 718)
- M4DUALARC — see M4DUALARC Data Sheet (form 990)

In addition, if you have purchased the M4RTUX I/O Extender, it is advisable to install the M4RTUXCAB extender cable after installing daughter cards — but before mounting the M4RTU/M4 I/O. See Opto 22 Modular Controller I/O Extender Data Sheet (form 671) for detailed instructions.

MOUNTING THE M4RTU/M4 I/O

Affix the M4RTU/M4 I/O to an enclosure or panel, either vertically or horizontally, using the mounting flanges shown in Figure 2-5 below. Use the mounting template provided to prepare the mounting site. Using user-supplied 1/4-20 screws, fasten the M4RTU/M4 I/O via flanges to the panel.

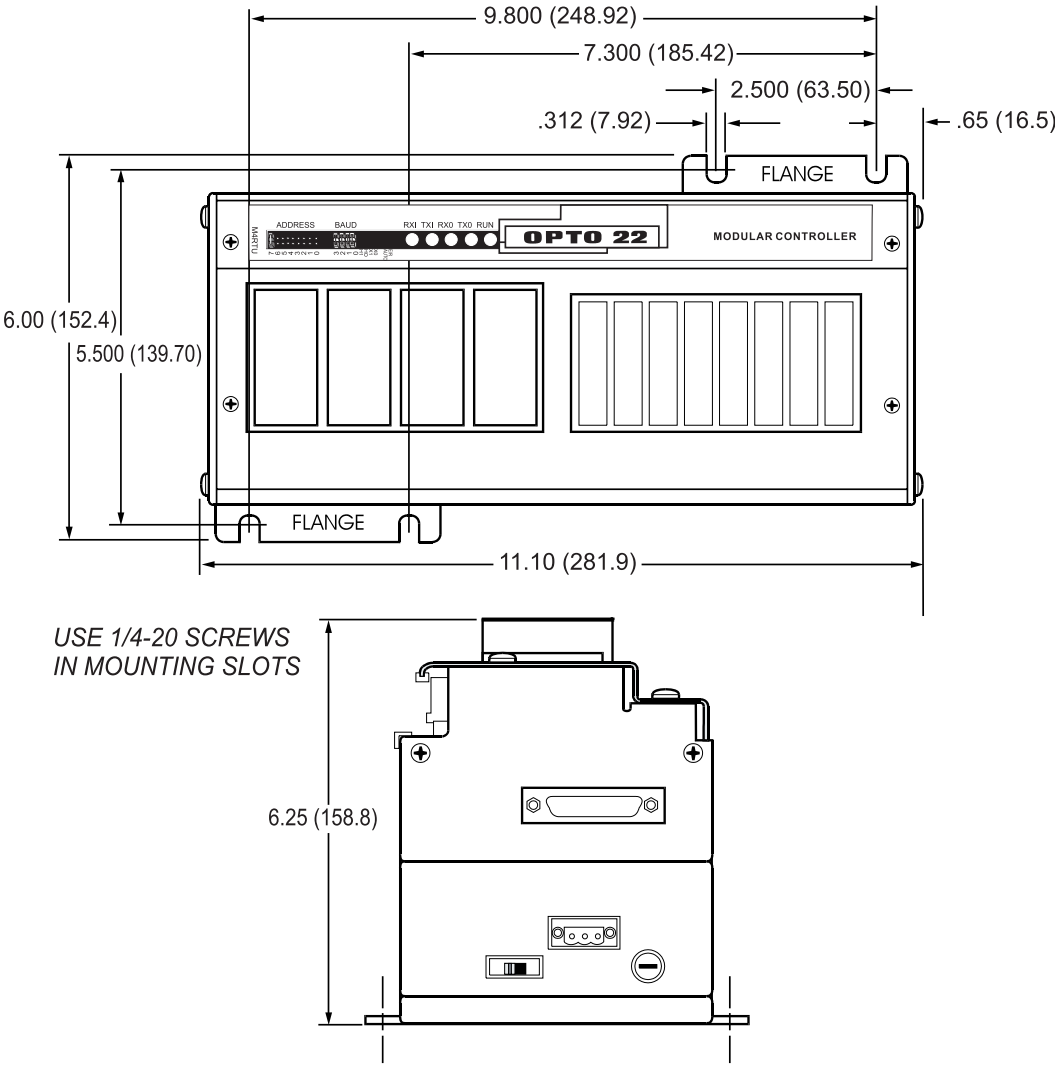


Figure 2-5: M4RTU/M4 I/O Dimensions and Mounting Information

CONNECTING TO A HOST PC

Wiring

RS-232 Pin Connections

The following diagram shows the pin positions for the M4RTU/M4 I/O COM0 serial port:

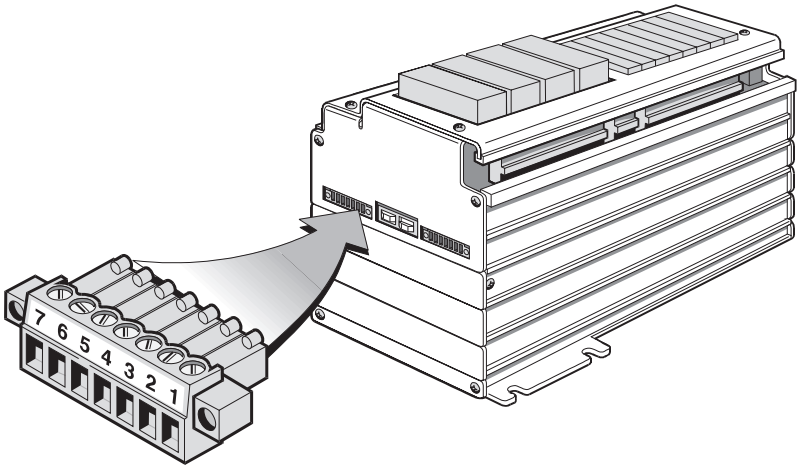


Figure 2-6: RS-232 COM0 Pin Positions

Refer to the table below to determine the function of each COM0 pin connection.

Table 2-2: Pin Connections for the M4RTU/M4 I/O COM0 Serial Port

1	Data Carrier Detect (DCD)
2	Transmit (TX)
3	Receive (RX)
4	Request-to-Send (RTS)
5	Clear-to-Send (CTS)
6	Data Terminal Ready (DTR)
7	Ground (GND)

RS-232 Wiring Scheme

Use the default host port (COM0) of the M4RTU/M4 I/O to connect to the host PC. Follow the diagram below to wire the M4RTU/M4 I/O RS-232 serial port to the serial connector on the PC. Verify that the pin connections at the host PC are the same as those called out in the diagram.

Important: *If RTS and CTS are not used, be sure to connect RTS to CTS on the M4RTU/M4 I/O as shown below.*

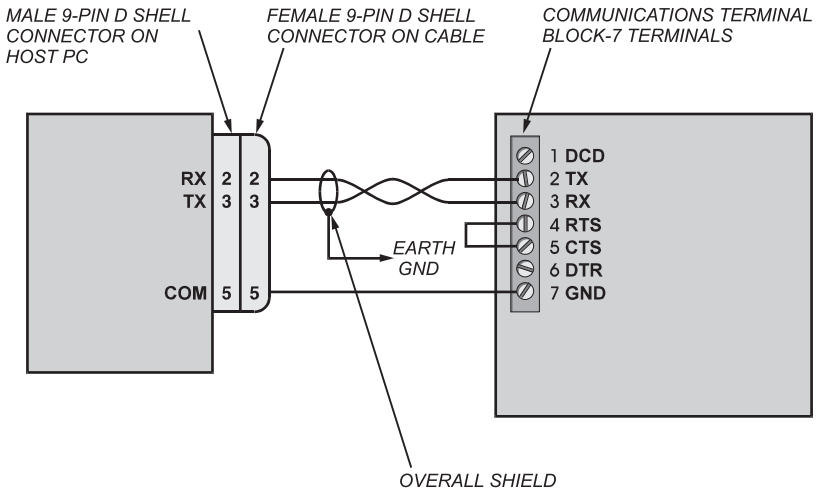


Figure 2-7: RS-232 Wiring Scheme

COMMUNICATION CONFIGURATION

Communications between the host PC and the M4RTU/M4 I/O must be configured using the graphical flowchart language OptoControl, which must be installed on the PC. For details, consult the *OptoControl User's Guide*.

To configure communications between the PC and M4RTU/M4 I/O, do the following:

1. Cycle the M4RTU/M4 I/O power by flipping the power switch off and then on (see Figure 2-8). Remember that the configuration jumpers and switches must be set **before** cycling power to the unit.
2. Open OptoTerm.
3. Configure a controller in OptoTerm with the communication settings that correspond to your configuration. Consult the *OptoControl User's Guide* for more information.

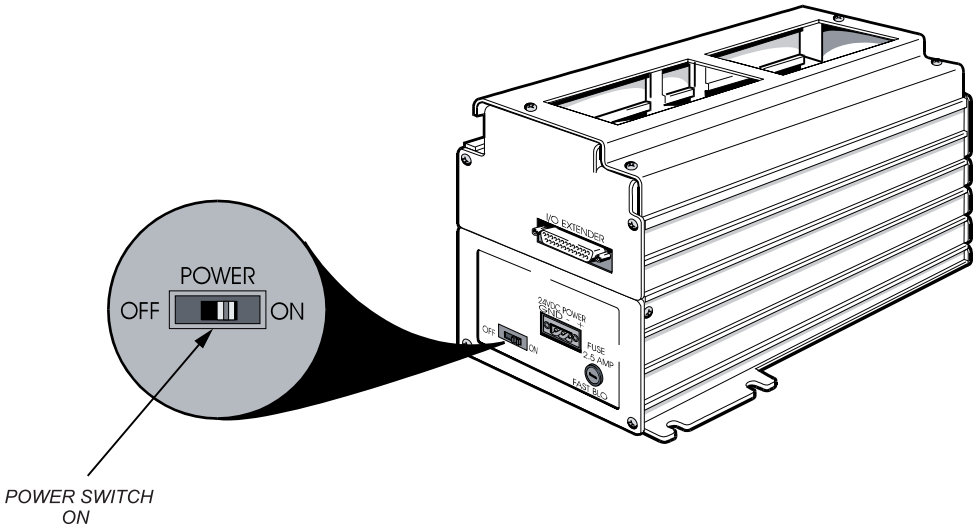


Figure 2-8: M4RTU/M4 I/O with Power Switch in ON Position

VERIFYING COMMUNICATIONS

To verify communications between the M4RTU/M4I/O and the host PC, use the OptoTerm utility which is included with FactoryFloor. In OptoTerm, highlight the controller to communicate with, and then select **VIEW** and then **STATUS** from the menu bar. If the PC can successfully communicate with the M4 controller, a window will pop up on the PC screen which displays information about the M4 controller. Information such as the M4 controller's kernel version, the name of the current strategy, and the controller's current date and time. If the communication is working correctly the time should update every one or two seconds, which can be verified by observing the seconds portion of the time field.

If you have not established successful communications between the two devices:

- Make sure you powered down and powered up the M4RTU/M4 I/O after changing any configuration jumpers. Refer to Chapter 3 — Installation and Setup to verify wiring connections and jumper setting.
- Check PC hardware and the physical connection between the M4RTU/M4 I/O and the PC.

CHAPTER 3

INSTALLATION AND SETUP

OVERVIEW

This chapter expands upon the quick start information in Chapter 2 with detailed instructions on installing and configuring the base M4RTU/M4 I/O. It also introduces procedures for installing optional expansion cards and connecting the optional M4RTUX Extender I/O unit. Detailed instructions on installing these optional units are provided in each unit's data sheet.

After unpacking the M4RTU/M4 I/O and power supply, review the packing list in Chapter 2 to ensure that all components are included. You may then proceed through the installation procedures below, as detailed in this chapter:

- Installing the power supply
- Connecting the backup battery
- Setting configuration jumpers and switches
- *(Optional)* Installing expansion cards
- *(Optional)* Connecting the M4RTUXCAB cable to the M4RTU/M4 I/O base unit
- Mounting the M4RTU/M4 I/O base unit
- Connecting power to the M4RTU/M4 I/O
- Installing I/O modules
- Connecting field wiring
- Connecting to a host PC or modem
- *(Optional)* Connecting to Opto 22 I/O.

Figures 3-1 and 3-2 provide two views of the M4RTU/M4 I/O base unit, with all components clearly labeled.

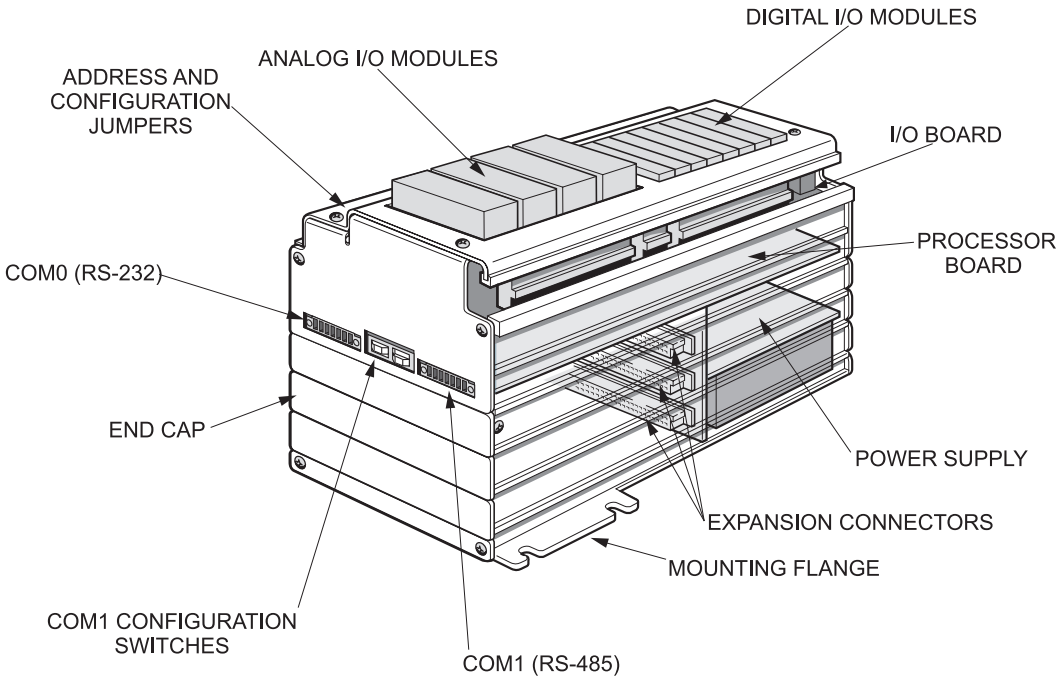


Figure 3-1: M4RTU/M4 I/O as Viewed from End with Expansion Slot and Serial Connector

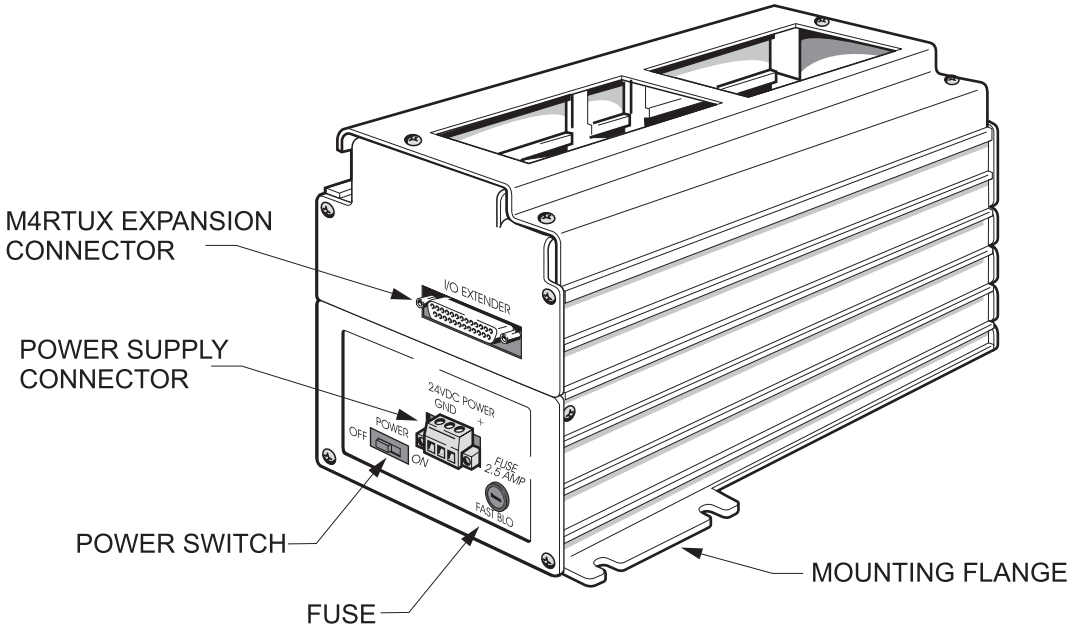


Figure 3-2: M4RTU/M4 I/O as Viewed from End with Power Supply and M4RTUX Connectors

INSTALLING THE POWER SUPPLY

Because different applications have different power requirements, the power supply is packaged separately from the M4RTU/M4 I/O. Table 3-1 shows available power supplies for the M4RTU/M4 I/O, along with their corresponding voltage input ranges.

Table 3-1: M4BUS Power Supplies and Input Voltage Ranges

Power Supply Model Number	Voltage	Frequency
M4PS12D	12 VDC input (9-15 V)	N/A
M4PS24D	24 VDC input (18-30 V)	N/A
M4PS48D	48 VDC input (36-60 V)	N/A
M4PS125D	125 VDC input (94-156 V)	N/A
M4PS120A	120 VDC input (95-130 V)	47-63 Hz
M4PS240A	240 VDC input (190-250 V)	47-63 Hz
M4PSF	Line Filter - requires 24 VDC and 5 VDC	N/A

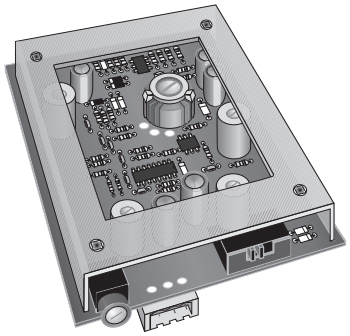


Figure 3-3 provides a view of the M4RTU/M4 I/O as a power supply is being installed. Use this diagram as a reference for the installation instructions.

1. Place the M4RTU/M4 I/O on a flat surface with the top cover (containing the I/O module channels) face up. Orient the unit as shown in Figure 3-3.
2. Unplug the power connector from the power supply and set aside. Place the power supply so it rests on the bottom of the cavity containing the M4BUS Power Supply 32-pin DIN connector. Slide the power supply into the cavity until it seats firmly against the connector. This will automatically align the four power supply screw holes located on the underside of the M4RTU/M4 I/O.
3. Locate the four flat-head screws included with the power supply and insert them into the holes on the underside of the M4RTU/M4 I/O. Tighten all four securely.
4. Place the power supply end cap on the M4RTU/M4 I/O so that the mounting holes line up. Tighten the end cap securely with the end cap screws supplied. Use the two 8-32 x 1/2 pan-head screws on the front and the two 4-40 x 1/4 pan-head screws on the sides.
5. Plug the power connector (removed in step 2) back into the power supply through the M4RTU/M4 I/O end cap.

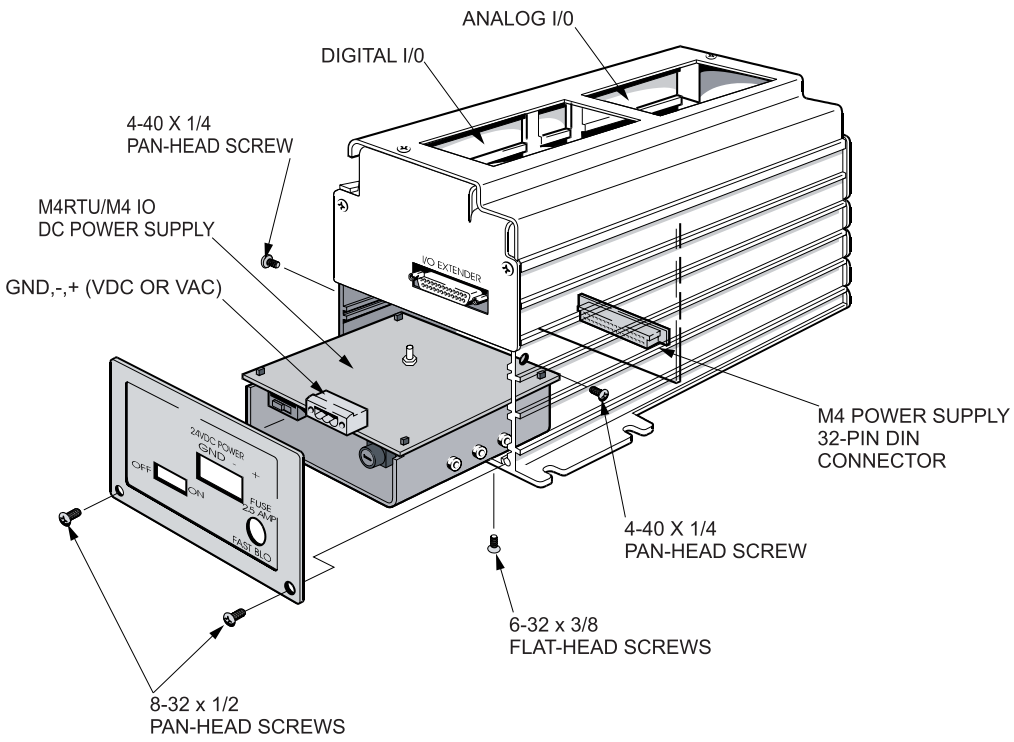


Figure 3-3: Installing the Power Supply on the M4RTU/M4 I/O

CONNECTING THE BACKUP BATTERY

The M4RTU/M4 I/O includes a RAM backup battery. This 3.6-volt lithium battery features a shelf life of up to 10 years and an operational life of two to five years.

To maintain operational life, the battery is not connected at the factory. You will need to connect it yourself. To do so, remove the top cover of the M4RTU/M4 I/O by removing the four corner screws. The battery is located at the far right of the unit. Attach the battery connection wire to the battery connection labeled J2. The connection wire will attach in one direction only, with the red wire connecting to the positive lead. Refer to Figure 3-4 to confirm battery and battery connection locations.

The Battery Service Record stamp adjacent to the J2 battery connection includes the Opto 22 part number of the battery (G4BATT32), the date the battery was installed, and the date the battery should be replaced (five years after installation). If the M4RTU/M4 I/O is subjected to temperature extremes, you should replace the battery after as little as two years.

To comply with Factory Mutual, section 3.2.7, replacement of the lithium battery must be done by the factory.

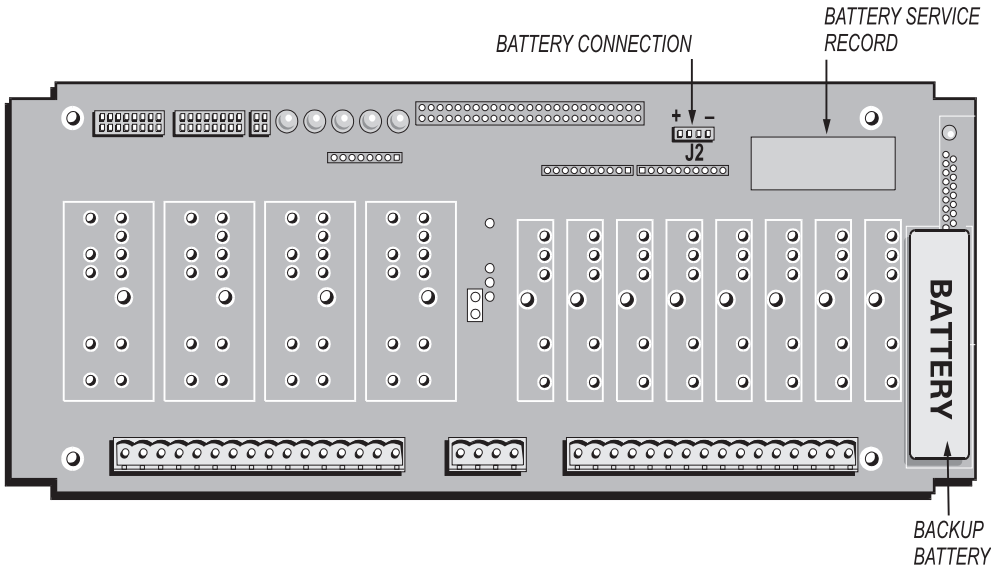


Figure 3-4: M4RTU/M4 I/O Backup Battery Location

SETTING CONFIGURATION JUMPERS AND SWITCHES

The M4RTU/M4 I/O includes jumpers and switches that allow you to configure the M4RTU/M4 I/O based on your individual application requirements. This section describes these configuration jumpers and switches.

I/O Board Jumpers

Figure 3-5 shows the location of 18 of the 21 M4RTU/M4 I/O jumpers. To access these jumpers, remove the top cover of the M4RTU/M4 I/O by removing the four corner screws. Note that a sticker is affixed to the underside of the cover to summarize the function of these jumpers.

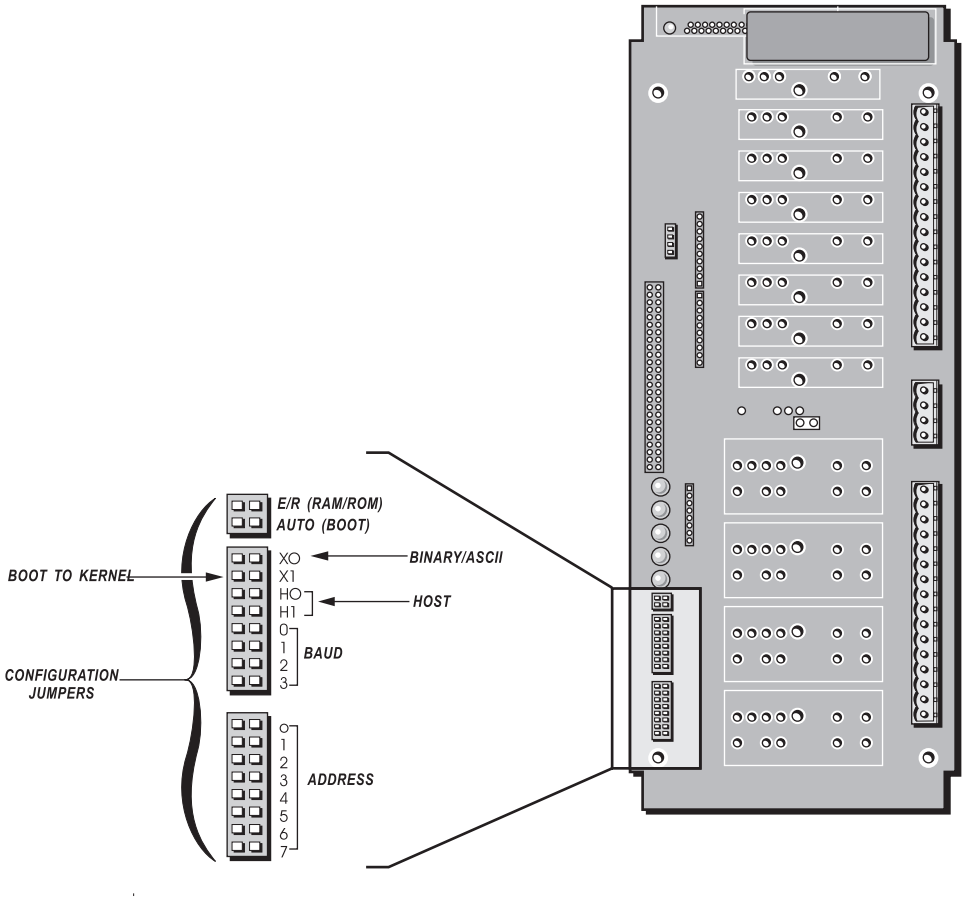


Figure 3-5: Configuration Jumpers on the M4RTU/M4 I/O Board

Table 3-2 describes the use and default settings of all I/O board jumpers. When a jumper is installed, the setting corresponding to the "In" position is in effect. When a jumper is not installed, the setting corresponding to the "Out" position is in effect.

Each jumper is described in detail on the following pages.

Table 3-2: M4RTU/M4 I/O Board Jumpers (factory defaults are highlighted)

Jumper(s)	Description	Position				Setting
E/R	EEPROM/RAM	**In**				**Run from RAM**
		Out				Run from EEPROM
Auto	Autoboot	In				Autoboot enabled
		Out				**Autoboot disabled**
X0	Communication	**In**				**Binary**
		Out				ASCII
X1	Boot Loader	**In**				**Boot to kernel**
		Out				Boot to loader
H0, H1	Host Port	H0		H1		
		In		**In**		**COM0**
		Out		In		COM1
		In		Out		ARCNET
		Out		Out		Ethernet
Baud 0-3	Baud Rate	0	1	2	3	
		Out	In	In	In	115.2 KBd
		In	Out	In	In	76.8 KBd
		Out	Out	In	In	57.6 KBd
		In	**In**	**Out**	**In**	**38.4 KBd**
		Out	In	Out	In	19.2 KBd
		In	Out	Out	In	9600 Bd
		Out	Out	Out	In	4800 Bd
		In	In	In	Out	2400 Bd
		Out	In	In	Out	1200 Bd
		In	Out	In	Out	600 Bd
		Out	Out	In	Out	300 Bd
Address 0-7	Address Bits	**Bit 0 In**				**1**
		Bit 1 In				2
		Bit 2 In				4
		Bit 3 In				8
		Bit 4 In				16
		Bit 5 In				32
		Bit 6 In				64
		Bit 7 In				128

EEPROM/RAM Jumper (E/R)

Use this jumper to choose the source of the M4RTU/M4 I/O's control program. When the jumper is in (the default), the control program will run from RAM; when the jumper is out, the control program is copied from Flash EEPROM into RAM and run from RAM.

Normally, application programs are downloaded from your PC workstation to battery-backed CMOS RAM in the M4RTU/M4 I/O. The programs are then executed from RAM. Unless application programs are stored in Flash EEPROM, the E/R jumper should be installed to allow the control program in RAM to run.

Autoboot Jumper (AUTO)

Use this jumper to determine whether autoboot mode will be enabled (jumper in) or disabled (jumper out, the default).

When autoboot mode is enabled, at power-up the M4RTU/M4 I/O automatically executes the resident user program (RAM or Flash). Otherwise, it waits to receive a command to run the resident program.

Communication Mode Jumper (X0)

Use this jumper to select whether communication between the host computer and the controller will be in binary mode (jumper in, the default) or ASCII mode (jumper out). Generally, ASCII mode is used in applications requiring a modem. For ARCNET or Ethernet this jumper is ignored. For more detailed information, refer to the OptoControl Command Reference Manual — Communications Overview.

Boot Loader Jumper (X1)

Use this jumper to set the controller to either boot to the downloaded kernel (jumper in, the default) or boot to loader (jumper out). This jumper should always remain in place for normal operations. For more information, see Appendix A (Troubleshooting).

Host Port Jumpers (H0, H1)

Use these jumpers to determine the primary host port used by the M4RTU/M4 I/O upon power-up or reset. Select from COM0 (both jumpers in, the default), COM1 (H0 jumper out, H1 jumper in), ARCNET (H0 jumper in, H1 jumper out), or Ethernet (both jumpers out).

COM0 is dedicated for RS-232 communications and COM1 is dedicated for RS-485 communications. Select ARCNET only if an optional M4SARC, M4SARCF, or M4SARCFR ARCNET expansion card is installed. Select Ethernet only if an optional M4SENETU or M4SENETC expansion card is installed.

Baud Rate Jumpers (BAUD 0–3)

Use these jumpers to set the baud rate for the host serial port (COM0 or COM1) on power-up or reset. Select the appropriate jumper settings based on the baud rates in Table 3-2. (These baud rates also appear on the sticker on the underside of the M4RTU/M4 I/O's top cover.) The default baud rate is 38.4 Kbps.

Note that if an optional ARCNET or Ethernet expansion card is installed and ARCNET or Ethernet is configured as the host, the baud rate jumper settings are irrelevant.

Use the *Configure Controllers - Setup Controller Ports* dialog box in OptoControl to set the baud rate for any M4RTU/M4 I/O serial port that is not being used as the primary host port. Consult the *OptoControl User's Guide* for more information.

Address Jumpers (ADDRESS 0–7)

Use these jumpers to select an 8-bit address from one to 255 (one to FF hexadecimal). The factory default is one (jumper zero in, all others out). The most significant bit is seven and the least significant bit is zero; address zero is reserved and should not used. Refer to Figure 3-6.

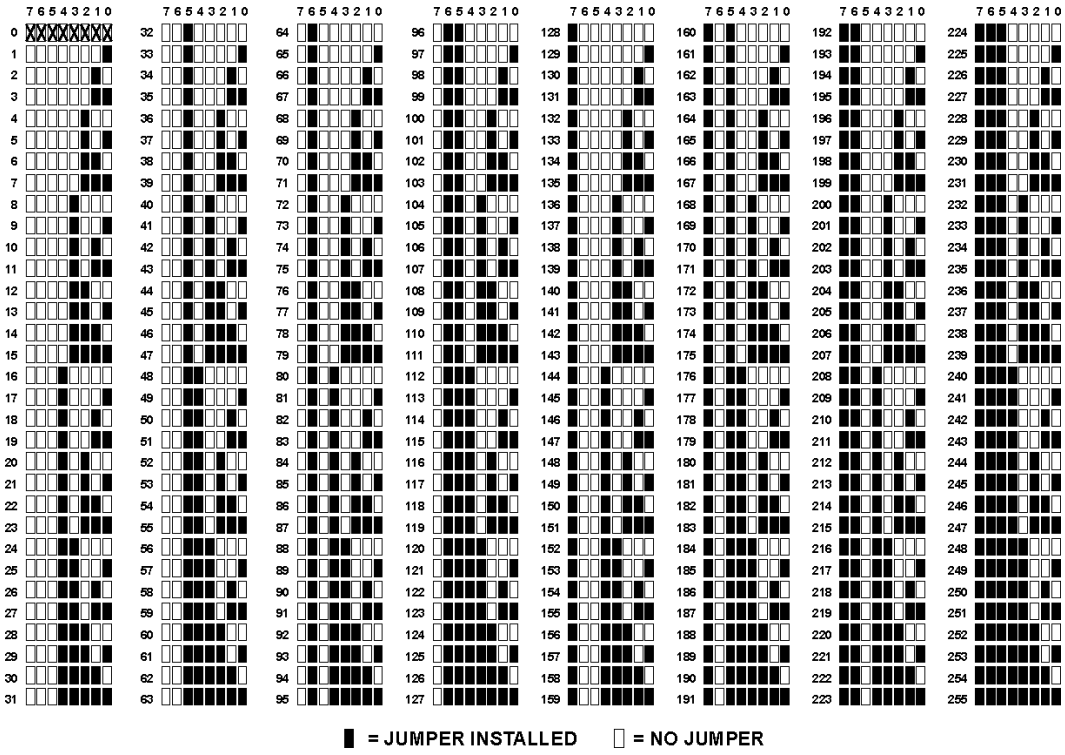


Figure 3-6: Address Jumper Setting

Processor Board Jumpers

Four additional jumpers are located on the main processor board, as shown below. For details on accessing these jumpers, see Appendix E (Upgrading RAM and Flash EEPROM).

Table 3-3 describes the use and default settings of all jumpers. When a jumper is installed, the setting corresponding to the "In" position is in effect. When a jumper is not installed, the setting corresponding to the "Out" position is in effect.

Each jumper is described in detail on the following pages.

Table 3-3 M4RTU/M4 I/O Configuration Jumpers (factory defaults are indicated in bold)

Jumper	Description	Position	Setting
FL	EPROM Type	In	UV EPROM (not used)
		Out	**Flash EEPROM**
MJ	RAM Size	*** In**	**2 x 1Mb (256 KB)**
		*** Out**	**2 x 4 Mb (1 MB)**
RJ	EPROM Size	**In**	**1 Mb Flash EEPROM (256 KB)**
		Out	4 Mb Flash EEPROM (1 MB) (Opto 22 P/N M4RTUF1M)
JP2	Ring Indicator	**In**	**COM0 Pin 7 is ground**
		Out	COM0 Pin 7 is ring indicator

Flash Jumpers (FL)

FL identifies the TYPE of firmware EPROMS (either FLASH or UV EPROMS). FL removed indicates FLASH EPROMS. FL installed indicates UV EPROMS. The default setting is for this jumper to be removed. All M4RTU/M4 I/O controllers have FLASH EPROMS, so this jumper should NEVER be installed.

*RAM Jumper (MJ)

MJ identifies the AMOUNT of RAM installed (and hence the TYPE of RAM chips). MJ installed indicates 256 KB (Kbytes) which is in the form of 2 chips that are 1 megabit each. MJ removed indicates 1 MB (megabyte) which is in the form of 2 chips that are 4 megabits each. If the M4RTU/M4 I/O has a "1 MB RAM Installed" sticker, the default setting is for this jumper to be removed. If the M4RTU/M4 I/O does not have this sticker, the default setting is for this jumper to be installed.

ROM Jumper (RJ)

RJ identifies the AMOUNT of EPROM memory installed (and hence the TYPE of EPROM chips) or vice versa. RJ installed indicates 256 KB (Kbytes) which is in the form of 2 chips that are 1 megabit each. RJ removed indicates 1 MB (megabyte) which is in the form of 2 chips that are 4 megabits each. The default setting is for this jumper to be installed.

Ring Indicator Jumper (JP2)

By default, this jumper is installed, establishing a ground on COM0 Pin 7 of the M4RTU/M4 I/O base unit. The jumper should remain installed under most circumstances.

If you need an extra programmable RS-232 input (such as a ring indicator), remove this jumper. Since this will eliminate the ground on COM0, it will be necessary to wire your RS-232 device ground to COM1 Pin 3 to prevent common mode problems and resulting damage.

Serial Port Switches (COM1)

The M4RTU/M4 I/O base unit comes standard with one RS-485 serial port COM1. This port includes configuration switches. The following diagram shows the serial port COM1 switches as they appear on the end cap of the M4RTU/M4 I/O. See below for details on configuring these switches.

TERM IN/TERM OUT

This switch selects termination for the RS-485 port. In the IN position, the RS-485 lines are terminated and biased. Terminate the port when it is physically the first or last unit in an RS-485 multi-drop serial network application.

In the OUT position, the RS-485 lines will be floating. This setting should be used when the port is part of a multi-drop serial network application and is not physically the first or last unit in the network. The default is TERM IN.

2-WIRE/4-WIRE

This switch selects the wiring method used to connect to the RS-485 serial port. The choices are 2-wire and 4-wire. The default is 4-wire. If you are using COM1 as an RS-485 serial link (remote), select 2-wire mode.

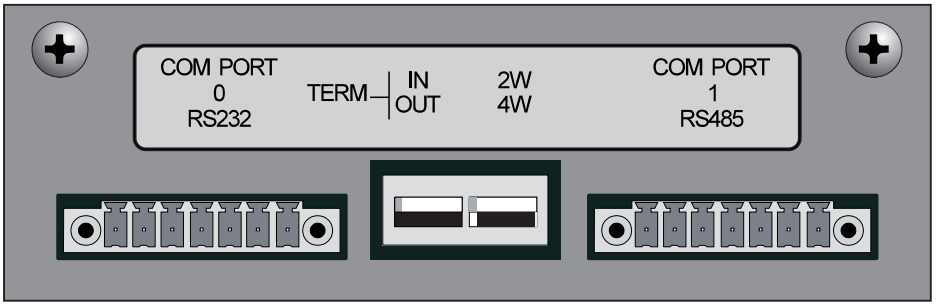


Figure 3-7: Serial Port COM1 Switches on the M4RTU/M4 I/O

INSTALLING EXPANSION CARDS

If you purchased expansion cards, you will need to install them in the M4RTU/M4 I/O before mounting the base unit.

The general procedure for installing optional cards is as follows:

1. If installed, remove the power connector from M4RTU/M4 I/O power supply.
2. Remove the end cap for any of the three expansion slots, located below the M4RTU/M4 I/O base unit serial connectors. Each end cap is held in place by two screws located on the side panel, adjacent to each end cap. (You may also need to remove one or two additional end caps to achieve proper card alignment.)
3. Align the edges of the card with the U-channels on the sides of the expansion bus cavity. Slide the card all the way in until it seats into the M4RTU/M4 I/O bus connector.
4. Use the original screws to attach the new end cap (included with the card) to the end of the M4RTU/M4 I/O unit.

See Figure 3-8 for reference. For complete details on installing the M4SSER, see M4 Serial Adapter Card Data Sheet (form 664). For details on installing expansion cards, see the appropriate expansion card data sheet. The form numbers can be found in Chapter 2, page 23 of this manual.

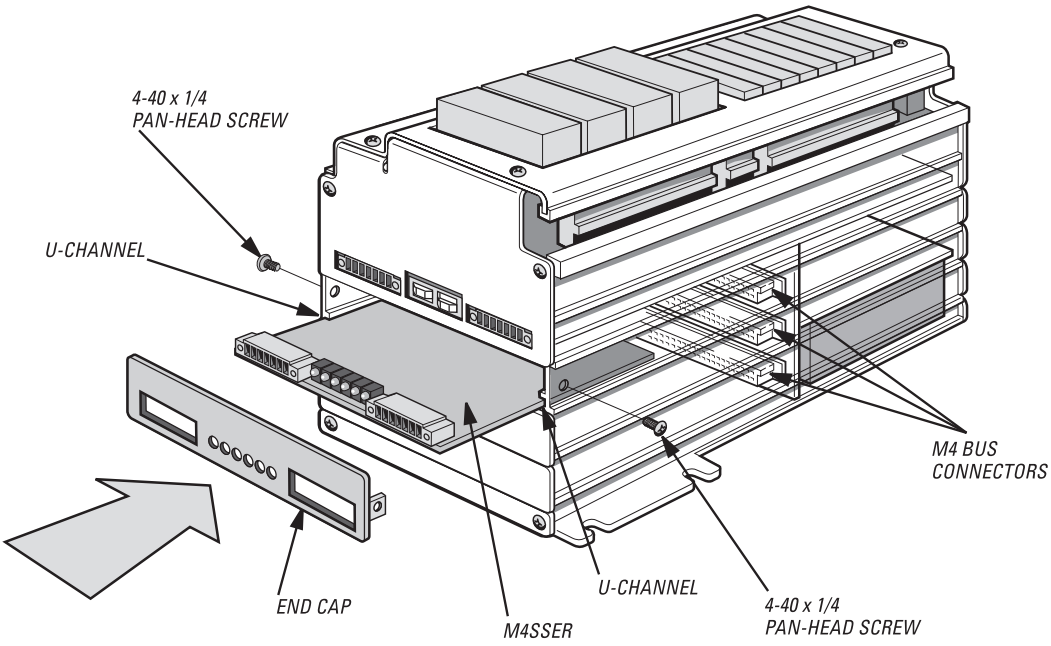


Figure 3-8: Installing an Expansion Card into the M4RTU/M4 I/O Expansion Slot

CONNECTING THE M4RTUXCAB CABLE TO THE M4RTU/M4 I/O BASE UNIT

The optional M4RTUX I/O Extender Unit expands the number of input/output points available to the M4RTU/M4 I/O from eight digital and four analog to 16 digital and eight analog.

If you plan to install the M4RTUX, you should attach the connecting cable (the M4RTUXCAB, packaged with the M4RTUX) to the M4RTU/M4 I/O before mounting the base unit. You can then elect to mount the extender unit right away or at some later time.

Brief procedures for connecting the M4RTUXCAB cable are provided below, along with a diagram illustrating where the cable should be attached. For complete details on installing the M4RTUX, see Modular Controller I/O Extender Data Sheet (form 671).

1. Locate the I/O Extender connector. This 25-pin D-shell connector can be found on the same end of the M4RTU/M4 I/O as the power supply connector.
2. Align the M4RTUXCAB connector with the I/O Extender connector on the base unit and seat properly.
3. Tighten the M4RTUXCAB connector locking screws to secure the cable to the base unit.

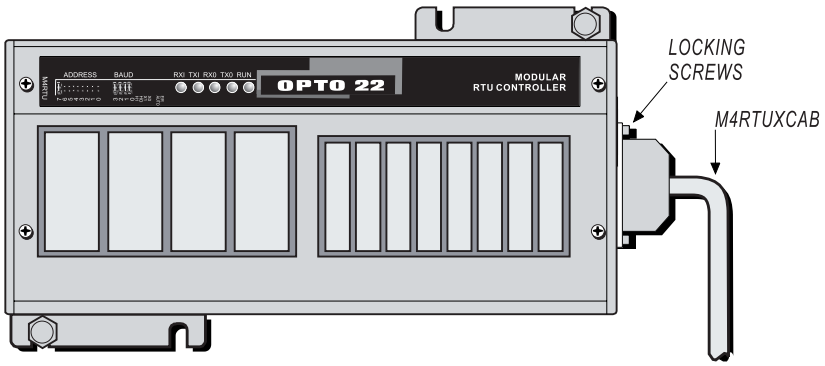


Figure 3-9: M4RTUXCAB Cable Connected to the M4RTU/M4 I/O Base Unit

MOUNTING THE M4RTU/M4 I/O BASE UNIT

Two flanges are located on the upper right and lower left back sides of the M4RTU/M4 I/O. Each flange has two mounting slots that can be used to fasten the M4RTU/M4 I/O to any enclosure or panel, either vertically or horizontally.

Note: *Be sure to install the power supply, any optional expansion cards, and the M4RTUXCAB on the M4RTU/M4 I/O before mounting the unit.*

The general procedure for mounting the M4RTU/M4 I/O base unit is as follows:

1. Determine panel mounting site and orientation (horizontal or vertical). Be sure to allow room for external connectors.
2. Tape the supplied mounting template onto the M4RTU/M4 I/O panel and prick-punch mounting locations.
3. Remove template and drill preliminary pilot holes.
4. Drill and tap (or drill through holes) for 1/4-20 screws.
5. Place M4RTU/M4 I/O onto mounting site and fasten with user-supplied 1/4-20 screws or screw and nut assemblies.

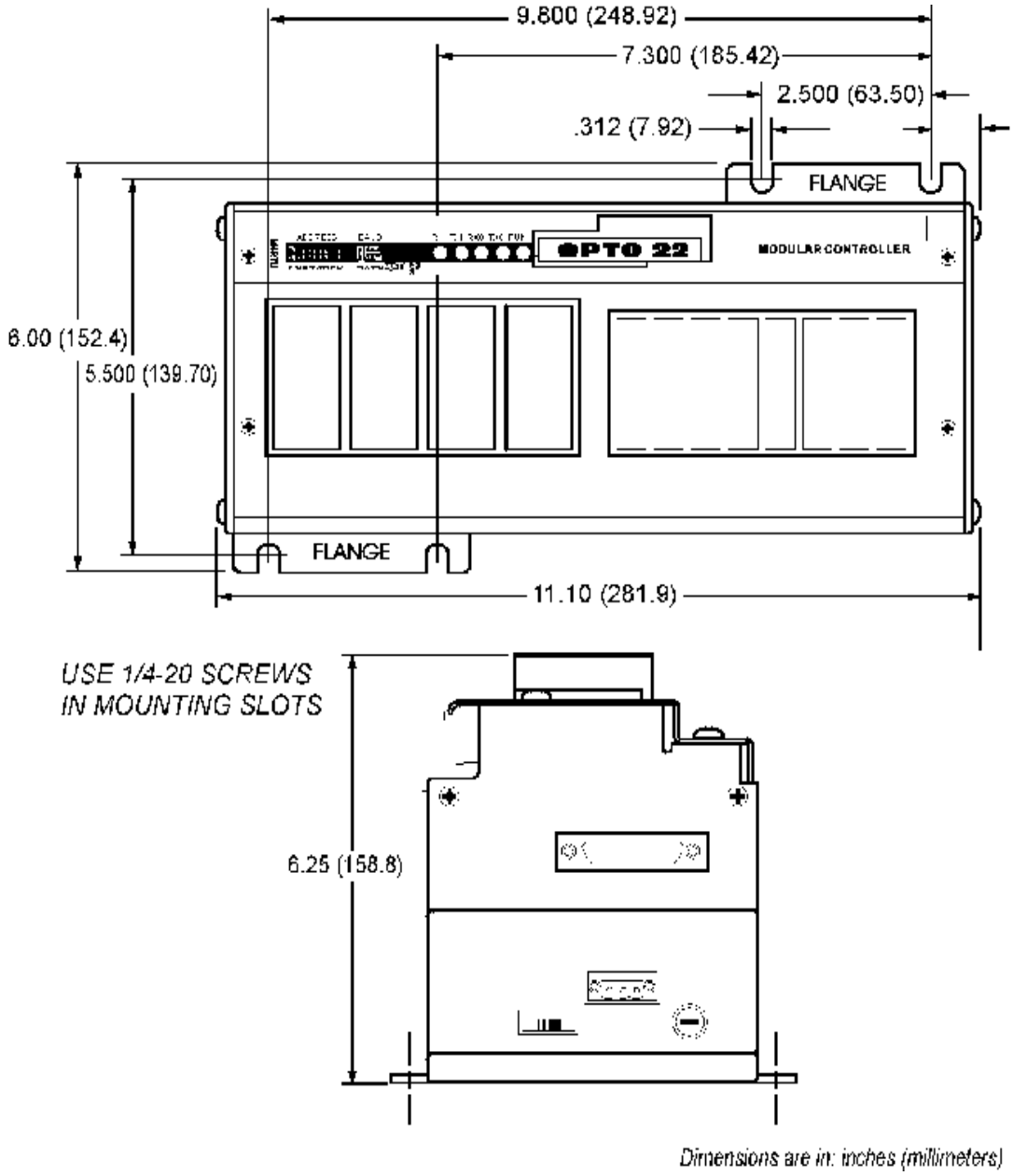


Figure 3-10: M4RTU/M4 I/O Dimensions and Mounting Information

CONNECTING POWER TO THE M4RTU/M4 I/O

Once you have mounted the M4RTU/M4 I/O, you are ready to connect power to the unit. Refer to Figure 3-11.

1. Turn off the power supply switch.
2. Make sure all power supply terminal block connections are completely open by turning the power terminal screws counterclockwise.
3. Prepare each power supply wire, being careful not to strip back the insulation too far.
4. Insert each wire into the appropriate terminal block location and tighten by turning the power terminal screw clockwise. Make sure the terminal block is clamping the wire and not the insulation.
5. Tighten power connector locking screws.

Note that steps 2–4 may be performed with the power supply connector removed from the power supply. Once steps 2–4 are complete, plug the power supply connector back into the M4RTU/M4 I/O and proceed to step 5.

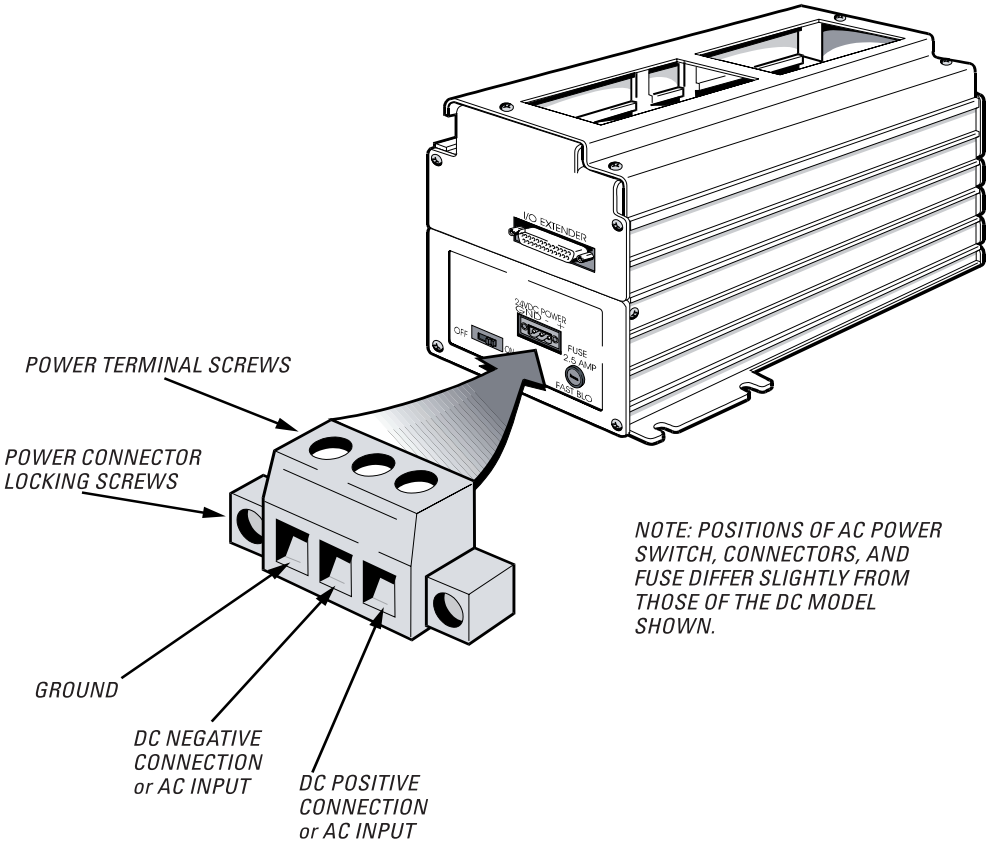


Figure 3-11: Connecting Power to the M4RTU/M4 I/O

INSTALLING I/O MODULES

Caution: *TURN OFF POWER to the M4RTU/M4 I/O before installing or removing I/O modules.*

The M4RTU/M4 I/O board, located at the top of the unit just below the top cover, accommodates eight digital and four analog G4 input/output modules. The placement for these modules is shown below.

To install I/O modules, you do not need to remove the top cover, unless you will be changing field wiring at the same time.

Install each digital or analog module as follows:

1. Choose the appropriate channel location on the M4RTU/M4 I/O board and carefully line up the I/O module pins with the sockets on the I/O board.
2. Press the module firmly into place until it seats all the way down on the I/O board.
3. Use a Phillips screwdriver to tighten the screw that will secure the I/O module.

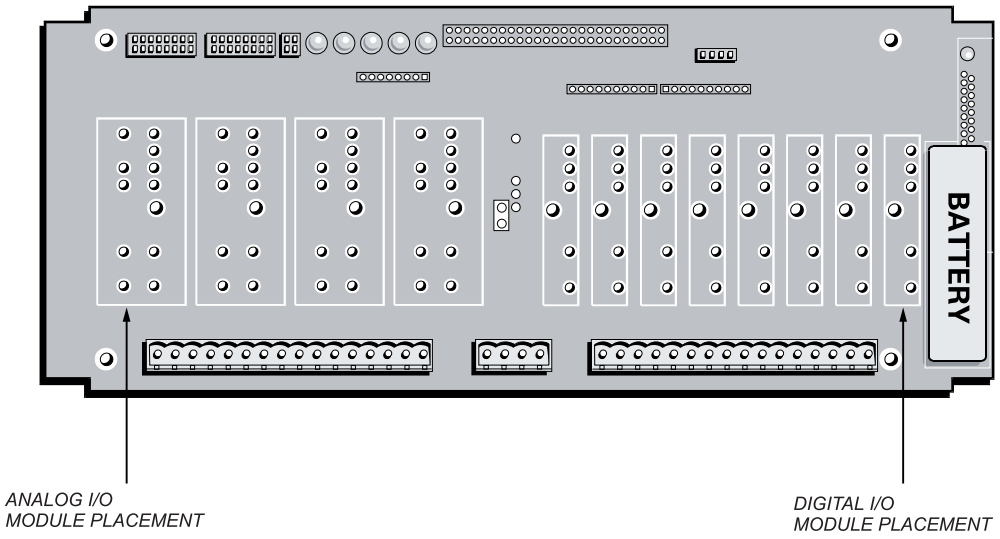


Figure 3-12: Placement of Digital and Analog Modules

CONNECTING FIELD WIRING

To access the field wiring terminals, you will first need to remove the top cover of the M4RTU/M4 I/O by removing the four corner screws at the top of the unit.

The pluggable field wiring terminals are located on the top of the M4RTU/M4 I/O board next to the corresponding digital or analog channels. These terminals allow field wires to be connected to the installed I/O modules.

Figure 3-13 shows the location of the terminals on the unit and the layout of the terminal points as they correspond to each I/O module.

Specific information on wiring digital and analog modules follows. For more detailed wiring information, refer to Chapter 5 (Field Wiring).

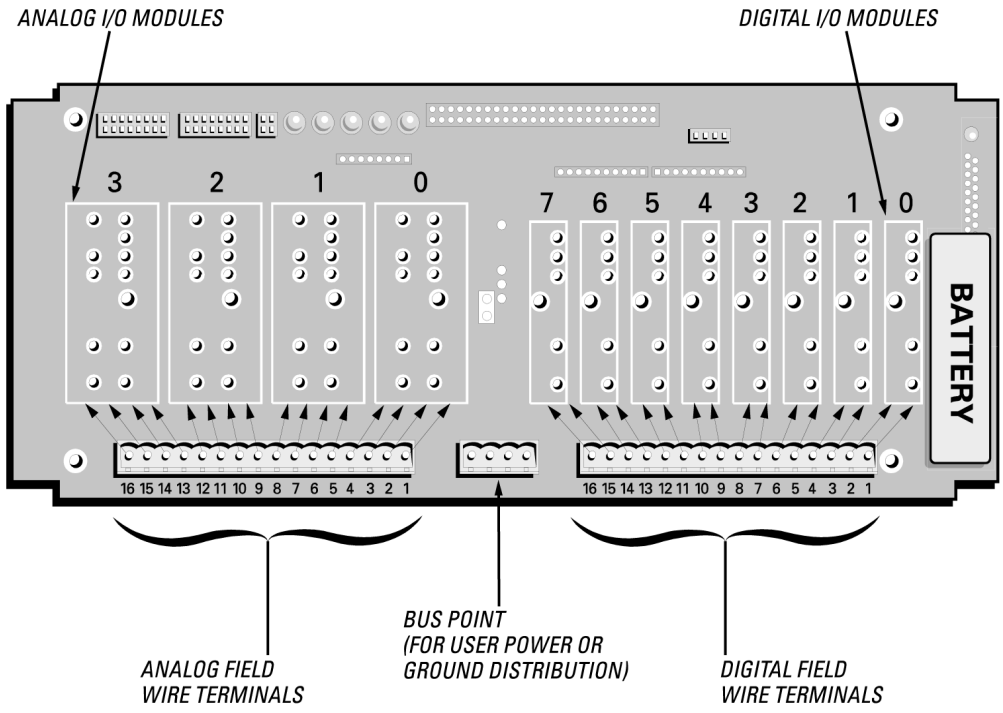

ANALOG I/O MODULES
DIGITAL I/O MODULES
3 2 1 0
7 6 5 4 3 2 1 0
BATTERY
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
ANALOG FIELD WIRE TERMINALS
BUS POINT (FOR USER POWER OR GROUND DISTRIBUTION)
DIGITAL FIELD WIRE TERMINALS

Figure 3-13: Locations of Terminals on the M4RTU/M4 I/O

Digital Modules

Digital modules have two terminals corresponding to each module. Figure 3-14 shows a G4IDC5 digital input module in channel zero wired with VIN + on terminal #1 and VIN - on terminal #2.

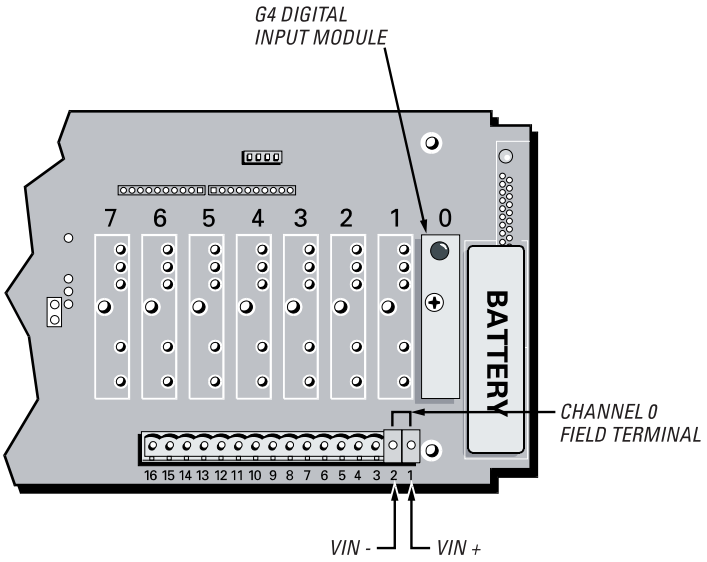


Figure 3-14: Digital Module Terminals

Analog Modules

Analog modules can use up to four terminals per I/O point. Figure 3-15 shows a G4AD6 0-5 VDC analog input module in channel zero wired with VIN - on terminal #2 and VIN + on terminal #4. Refer to Chapter 5 for wiring other analog modules.

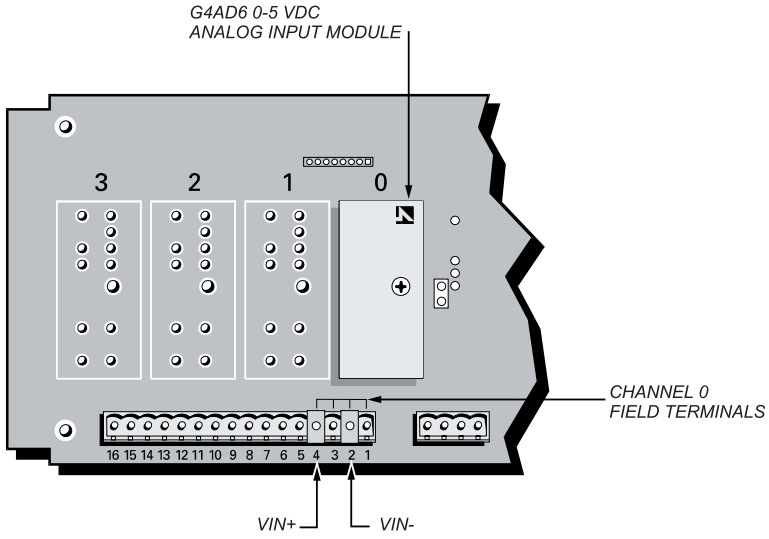


Figure 3-15: Wiring for Analog Module G4AD6

CONNECTING TO A HOST PC OR MODEM

The M4RTU/M4 I/O features two built-in serial ports, COM0 (RS-232) and COM1 (RS-485), with a data transfer rate of 300 Bd to 115.2 Kbps. Two additional serial ports are available by installing an optional M4SSER serial expansion card into one of the M4RTU/M4 I/O expansion card slots. (See Chapter 4 for complete information.)

Wiring

Important: *Serial port connectors wired for other Opto 22 controllers may not be compatible with the M4RTU/M4 I/O. Use the M4RTU/M4 I/O connectors provided and refer to the diagrams in this manual for wiring information.*

The following sections describe wiring for the serial ports found on the M4RTU/M4 I/O base unit. Use Tables 3-3 and 3-4 as a reference for wiring the pluggable, 7-terminal serial port connectors, shown in Figure 3-16.

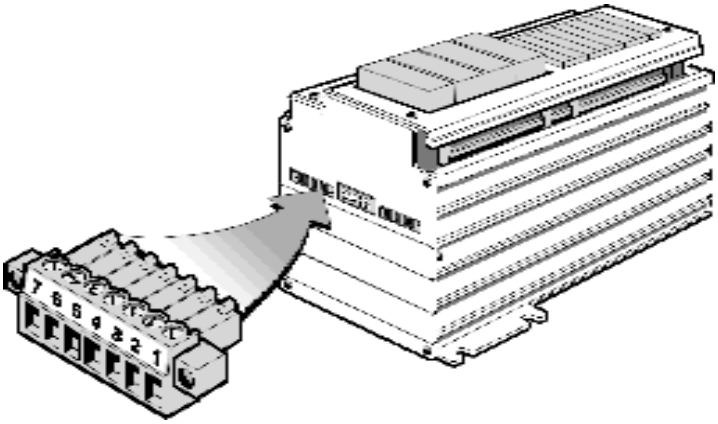


Figure 3-16: 7-Terminal Serial Port Connectors

RS-232 COM0 Pin Connections

The M4RTU/M4 I/O has one built-in RS-232 COM0 serial port. Table 3-4 contains descriptions for each COM0 pin.

Important: *If RTS and CTS are not used, RTS must be connected to CTS (COM0 only) on the M4RTU/M4 I/O.*

PIN CONNECTIONS/DESCRIPTIONS

Table 3-4: Pin Descriptions for the M4RTU/M4 I/O COM0 Serial Port

Pin	COM0
1	Data Carrier Detect (DCD)
2	Transmit (TX)
3	Receive (RX)
4	Request-to-Send (RTS)
5	Clear-to-Send (CTS)
6	Data Terminal Ready (DTR)
7	Ground (GND)

RS-485 COM1 Pin Connections

An RS-485 COM1 port is also built into the M4RTU/M4 I/O base unit. Table 3-5 contains descriptions for each COM1 pin for both 2-wire and 4-wire modes.

Note that the interrupt lines can be used to add interrupt capability to Opto 22 I/O units connected to an M4RTU/M4 I/O via an RS-485 serial link (remote).

Table 3-5: Pin Descriptions for the M4RTU/M4 I/O COM1 Serial Port

Pin	2-wire Mode	4-wire Mode
1	Transmit/Receive Plus (TX/RX +)	Transmit Plus (TX +)
2	Transmit/Receive Minus (TX/RX -)	Transmit Minus (TX -)
3	Common Ground (GND)	Common Ground (GND)
4	No Connection (N/C)	Receive Plus (RX +)
5	No Connection (N/C)	Receive Minus (RX -)
6	Interrupt Plus (IRQ +)	Interrupt Plus (IRQ +)
7	Interrupt Minus (IRQ -)	Interrupt Minus (IRQ -)

Wiring to a Host PC

This section provides information on wiring connections between an M4RTU/M4 I/O and a host personal computer. Examples show connections to a standard PC serial port and an Opto 22 AC37.

Be sure to use cable appropriate to your application. See Appendix B for a complete list of recommended cables.

RS-232 COM0

Make RS-232 communication connections to a host PC by using the RS-232 COM0 default host connector on the M4RTU/M4 I/O.

Refer to Figure 3-17 to connect the M4RTU/M4 I/O to the serial port of a host PC. Verify that the pin connections at the host PC are the same as those called out in the diagram.

Important: *If RTS and CTS are not used, RTS must be connected to CTS (COM0 only) on the M4RTU/M4 I/O, as shown below.*

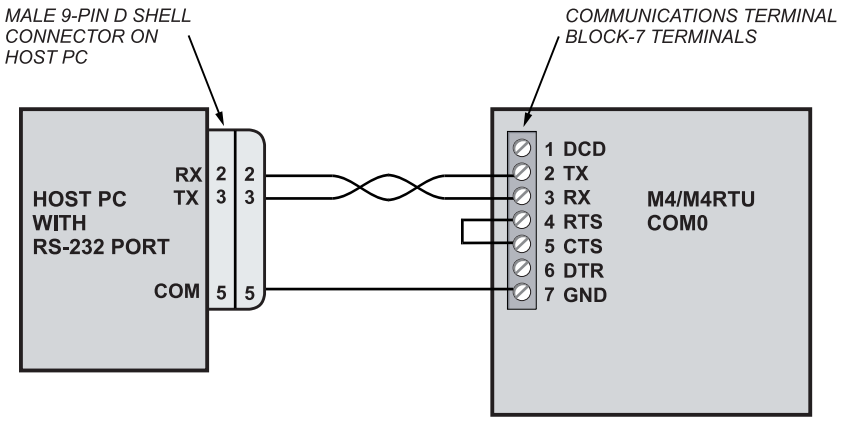


Figure 3-17: RS-232 Wiring to a Host PC

RS-485 COM1

4-Wire Mode Using an AC37

If you are using an Opto 22 AC37, connect the end of the cable with a male 9-pin D-shell connector to the converter and the other end with a pluggable terminal block to the M4RTU/M4 I/O. Refer to Figure 3-18 and Figure 3-19 for wiring details.

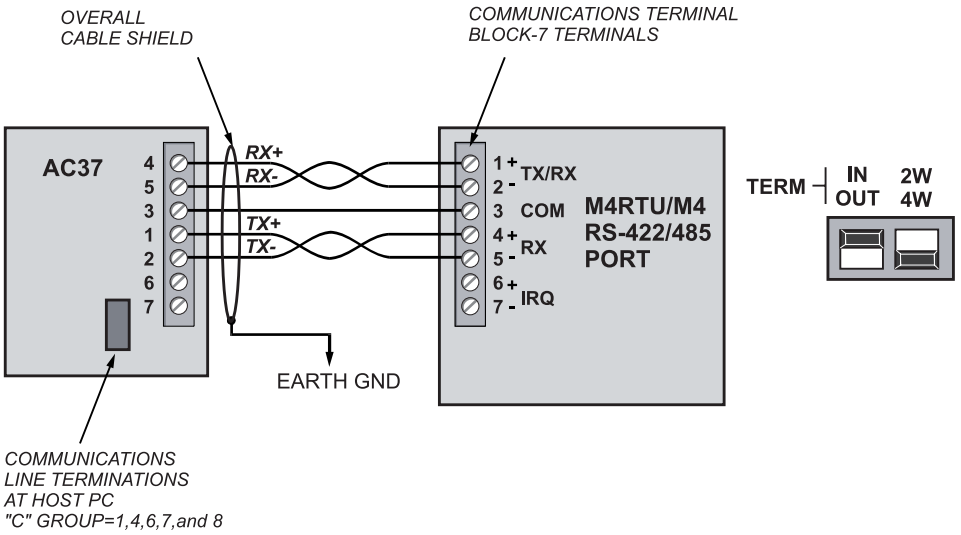


Figure 3-18: RS-485 Wiring to a Host PC in 4-Wire Mode Using an AC37

2-Wire Mode Using an AC37

The AC37 also supports a 2-wire mode. Refer to the following diagram for wiring.

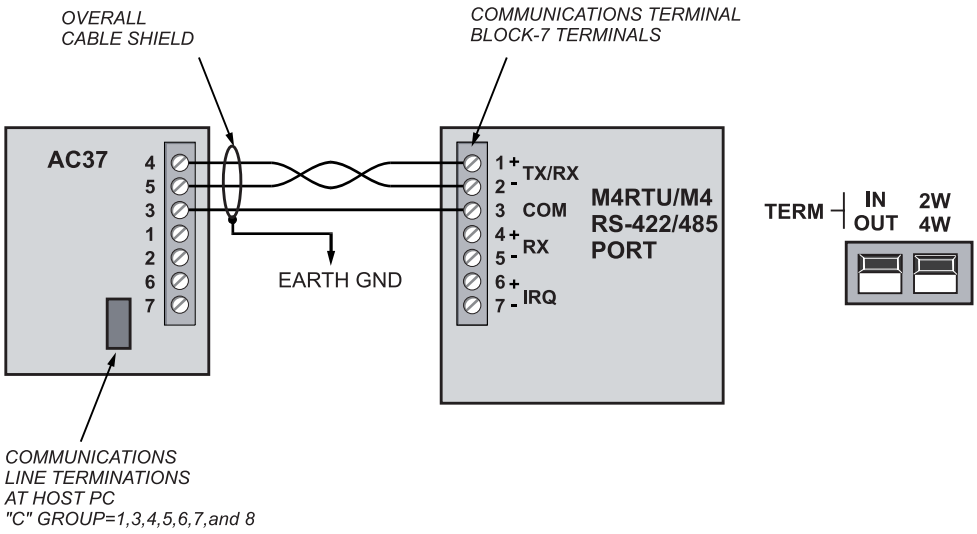


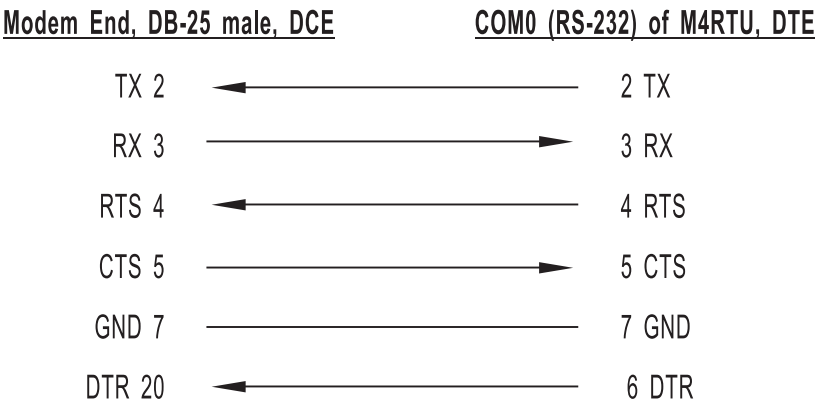
Figure 3-19: RS-485 Wiring to a Host PC in 2-Wire Mode Using an AC37

WIRING TO A MODEM (A DCE DEVICE)

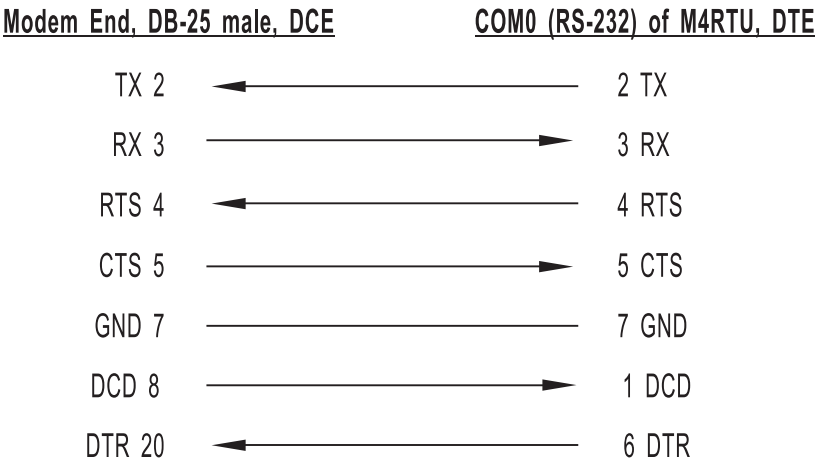
Refer to your modem documentation for detailed wiring information, possible jumper configuration, and initialization setup. You may also wish to refer to Opto 22's communication application notes, available through Opto 22's Bulletin Board Service (see Appendix G for details).

Most standard external PC modems can be usd with the M4RTU/M4 I/O. However, a custom (or special) communications cable must be used between the modem and the M4RTU/M4 I/O. Wiring diagrams for this cable are shown below:

Suggested Modem to M4RTU Cable (without carrier detect):



Suggested Modem to M4RTU Cable (with carrier detect):



Computer (DTE) RS-232 COM Port Pin Assignments

RS-232 25-pin

Pin	Name	Abbreviation
1	Protective Ground	----------
2	Transmitted Data	TD
3	Received Data	RD
4	Request to Send	RTS
5	Clear to Send	CTS
6	Data Set Ready	DSR
7	Signal Common	----------
8	Data Carrier Detect	DCD
20	Data Terminal Ready	DTR
22	Ring Indicator	RI

RS-232 9-pin

Pin	Name	Abbreviation
1	Data Carrier Detect	DCD
2	Received Data	RD
3	Transmitted Data	TD
4	Data Terminal Ready	DTR
5	Signal Ground	----------
6	Dat Set Ready	DSR
7	Request to Send	RTS
8	Clear to Send	CTS
9	Ring Indicator	RI

CONNECTING TO OPTO 22 I/O UNITS

The built-in RS-485 COM1 port can be used as a serial link (remote) to communicate with Opto 22 digital or analog I/O. A M4SSER serial expansion card installed in the M4RTU/M4 I/O can also be used for this purpose.

One method for doing this is to use a Mistic 200 I/O Remote Interface board (G4IOR) as illustrated in Figure 3-20. This method allows the use of Opto 22 I/O equipment (G4 panels, cables, etc.).

Figure 3-20 shows a 2-wire RS-485 shielded connection from COM1 on the M4RTU/M4 I/O to the G4IOR Remote Interface board. Connect Pin 1 (TX/RX+) to G4IOR "TH+," Pin 2 (TX/RX-) to G4IOR "TH-," and Pin 3 to "COM." If you are using the interrupt lines, connect Pin 6 to "IRQ+" and Pin 7 to "IRQ-."

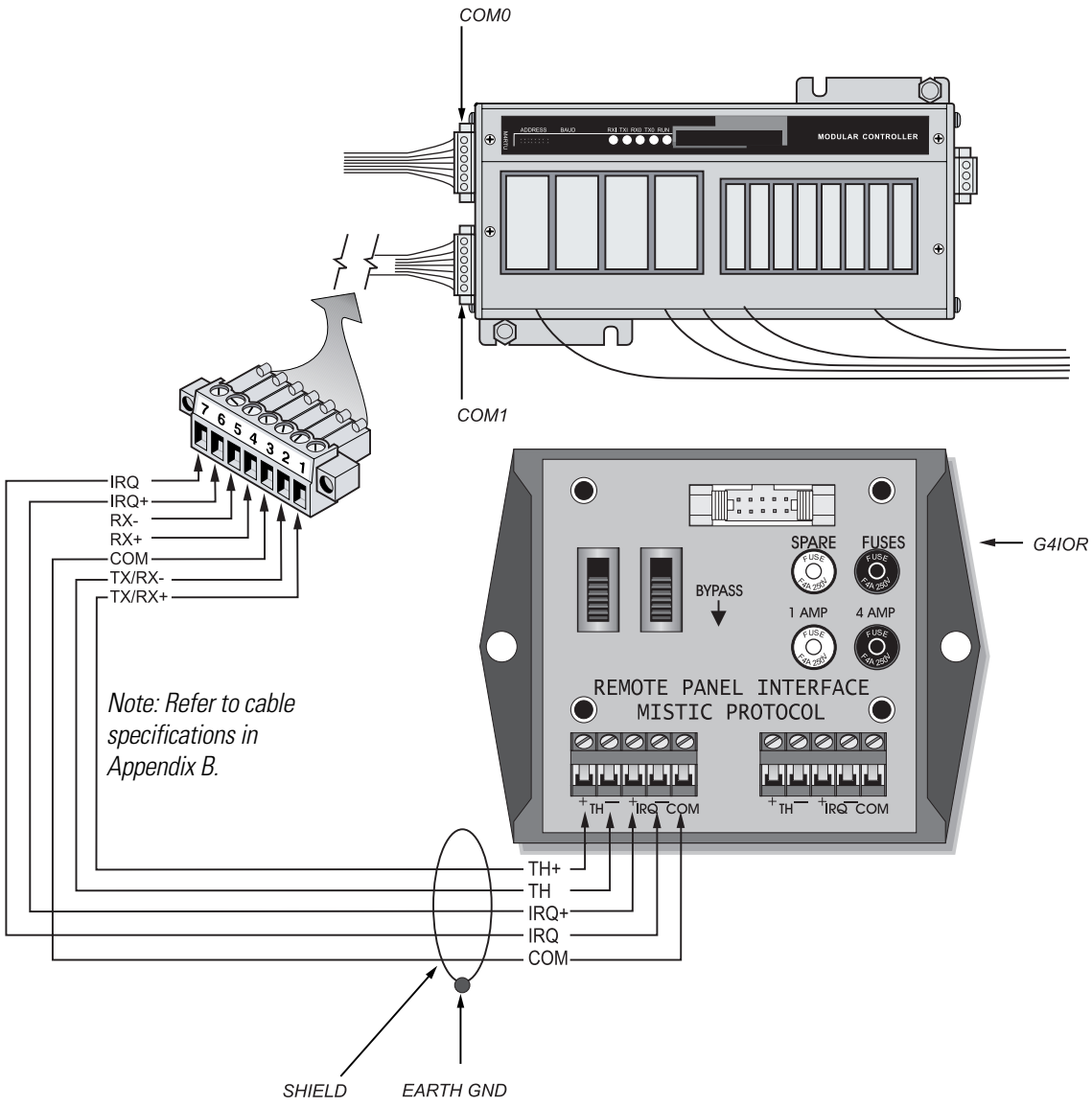


Figure 3-20: Communications to a Remote Interface (G4IOR)

Another method for using the RS-485 COM1 port as an RS-485 serial link (remote) is to use Opto 22 I/O units installed with a SBTA, as illustrated in Figure 3-21. This allows you to accommodate your own installation practices, application requirements, and cables. Simply mount your I/O units throughout your installation and daisy chain communication cable between them. Refer to the *Mistic 200 Systems Installation Guide* for more SBTA details.

Note: Refer to cable specifications in Appendix B.

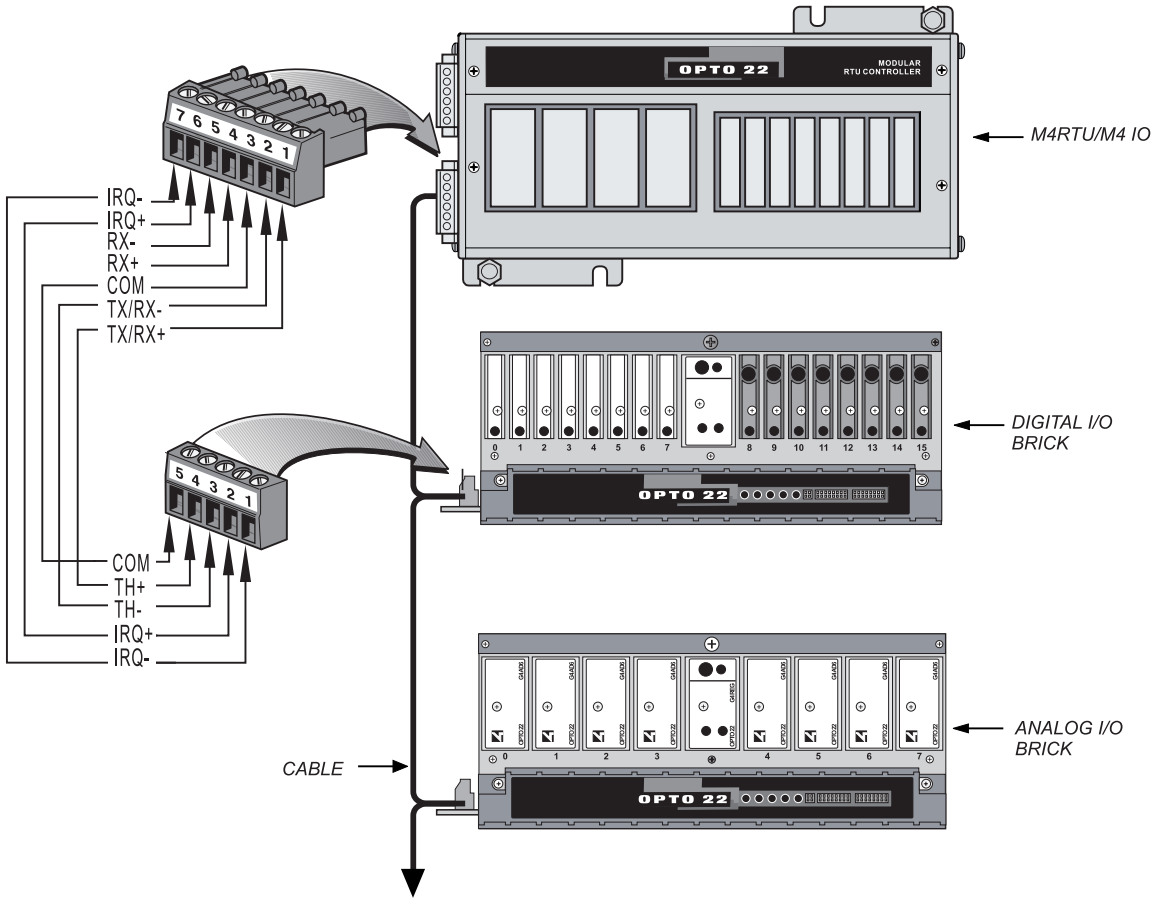


Figure 3-21: Opto 22 I/O Units Installed with SBTA

LED INDICATORS

Five LEDs are located on the top of the M4RTU/M4 I/O, in line with the configuration jumpers, as shown in Figure 3-24. These LEDs perform the functions displayed in Table 3-6 below.

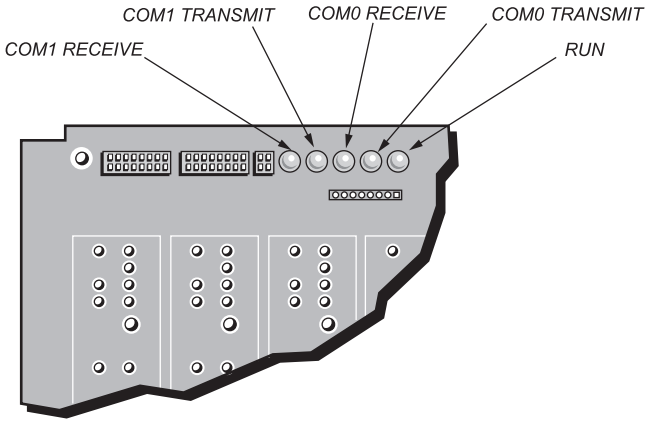


Figure 3-22: LED Indicators on the M4RTU/M4 I/O

Table 3-6: LED Functions

LED	Indication
RUN (Processor status)	This indicator shows processor status. When the processor is functioning normally, the light stays on. When the processor is powered down, the light goes off. If the light blinks, it could indicate a processor malfunction or low power supply voltage.
TX0 (COM0 transmit)	This indicator illuminates whenever COM0 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle, a wiring problem exists, or CTS is low.
RX0 (COM0 receive)	This indicator illuminates whenever COM0 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
TX1 (COM1 transmit)	This indicator illuminates whenever COM1 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
RX1 (COM1 receive)	This indicator illuminates whenever COM1 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.

SOFTWARE AND FIRMWARE

OVERVIEW

This chapter provides information on using OptoControl, OptoDisplay, and OptoServer with the M4RTU/M4 I/O. OptoControl is used to program and debug M4RTU/M4 I/O control strategies. OptoDisplay is used to create M4RTU/M4 I/O process operator interfaces running on the PC. OptoServer allows the user to construct complex client/server architectures running multiple OptoDisplay sessions, DDE-aware applications (such as Microsoft Excel), or third-party software packages with OptoServer driver capability. The tight integration between OptoControl, OptoDisplay, and OptoServer not only makes all three software packages easy to use, it also prevents multiple database entry errors, allows tag name validation, and takes full advantage of the M4RTU/M4 I/O's hardware capabilities.

The sophisticated firmware of both the main and I/O processors of the M4RTU/M4 I/O, along with flash technology, enables a user to update the M4RTU/M4 I/O remotely with a new set of operating systems for the main and I/O processors. The firmware also supports the ability to store a user's strategy permanently into flash memory.

Note: *It is not the intent of this chapter to teach OptoControl programming and debugging, OptoDisplay configuration and runtime operation, or overall OptoServer usage. Instead, this chapter presents an overview of these topics, with enough details to get you started. For detailed information on these subjects, refer to the appropriate Opto 22 user guides.*

OPTOCONTROL

OptoControl is used to configure communications between the PC and the M4RTU/M4 I/O, configure the I/O units and points, and develop and run your control strategy.

Configuring Communications to the M4RTU/M4 I/O

To download OptoControl strategies to the M4RTU/M4 I/O and debug them, you must first configure the communication link between the host PC and the M4RTU/M4 I/O. Begin by deciding what type of physical communication link will be used (ARCNET, RS-232, RS-485/422, or Ethernet). Next, install and configure communication hardware between the host PC and the M4RTU/M4 I/O. (Refer to the appropriate PC and M4RTU/M4 I/O documentation for communication hardware installation details.)

Once the hardware has been installed, OptoControl must be configured to communicate over the physical communication link. Refer to Chapter 6 of the *OptoControl User's Guide* to configure PC communications to the M4RTU/M4 I/O.

Configuring the M4RTU/M4 I/O and M4RTUX

Before writing OptoControl strategies for the M4RTU/M4 I/O, you must inform OptoControl about the I/O installed on or connected to the M4RTU/M4 I/O and, if applicable, the M4RTUX.

OptoControl must know how the I/O units are connected to a controller (i.e., via the parallel I/O bus [local] or RS-485 serial link [remote]) as well as what type of module will be installed into each I/O channel on each unit. Once OptoControl has this information, you may use the assigned I/O tag names to reference the I/O within an OptoControl strategy.

Note that the multifunction digital I/O unit (M4RTU/M4 I/O digital I/O) is addressed as 0 and the multifunction analog I/O unit (M4RTU/M4 I/O analog I/O) is addressed as 1 on the parallel I/O bus (local). Since there is no external local bus on the M4RTU/M4 I/O, these are the only two valid local bus addresses. These addresses are important during I/O configuration within OptoControl.

Configuring M4RTU/M4 I/O and M4RTUX I/O Units

The first step in configuring I/O is adding the I/O units. Follow the procedure listed in Chapter 6 of the OptoControl User's Guide to add an I/O unit. For the digital unit, the Type is G4 Digital Multifunction, the Port is Local, and the Address is 0. For the analog unit, the Type is G4 Analog Multifunction , the Port is Local, and the Address is 1. Remember that the digital I/O on the M4RTUX is on the same unit as the digital I/O on the M4RTU/M4 I/O, and the analog I/O on the M4RTUX is on the same unit as the analog I/O on the M4RTU/M4 I/O.

Configuring Additional I/O Units

Your system may have additional I/O units connected via the RS-485 serial link. Follow the procedure listed in Chapter 6 of the *OptoControl User's Guide* to add an I/O unit. For the configuration of these units, the **Port** is *Remote 1, 2, or 3* depending on where the I/O is located. The **Type** and **Address** will depend on the hardware used and the jumper settings.

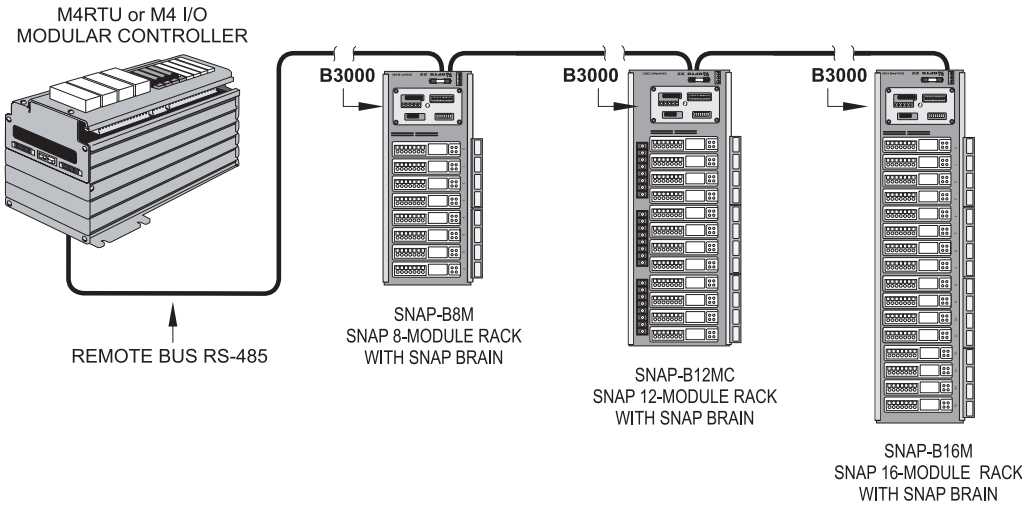


Figure 4-1: Representation of the M4RTU/M4 I/O and SNAP I/O

Configuring the I/O Points

Follow the procedure listed in Chapter 6 of the *OptoControl User's Guide* to add an I/O point. Notice that the *Configure I/O Points* dialog box shows 16 analog channels even though the M4RTU/M4 I/O and M4RTUX together support a maximum of only eight analog channels. This is because the M4RTU/M4 I/O electronics does not support the analog extender capability of an analog multifunction I/O unit. Simply ignore analog channels 8 through 15 of the *Configure I/O Points* dialog box.

Storing User Strategies into M4RTU/M4 I/O Flash EEPROM

User OptoControl strategies may be stored into flash memory instead of residing in RAM backed up by a battery. Flash memory has the same robust attributes of EEPROM for remote installations. Strategies may be developed for the M4RTU/M4 I/O in RAM, remotely downloaded and debugged, and then stored remotely in flash memory. If the M4RTU/M4 I/O has been set up to boot automatically from flash memory, the OptoControl strategy stored in flash will be executed upon power-up.

To store an OptoControl strategy into flash memory, refer to Chapter 9 of the *OptoControl User's Guide*.

To configure the M4RTU to run the program automatically from flash, refer to Chapter 3, page 35.

OPTODISPLAY AND OPTOSERVER

Both OptoDisplay and OptoServer share the database generated by OptoControl. This database contains the configuration information for communicating to the M4RTU/M4 I/O and referencing any strategy data items, such as variables, I/O, PIDs, and event/reactions. This information is used by OptoDisplay to dynamically drive a given graphic's attributes. It is also used by OptoServer to communicate to an M4RTU/M4 I/O or an Opto 22 Controller Network of M4RTU/M4 I/Os and other Opto 22 controllers.

To attach OptoDisplay or OptoServer to an M4RTU/M4 I/O (or to an Opto 22 Controller Network containing M4RTU/M4 I/Os), follow the standard procedures outlined in the OptoDisplay and OptoServer online help or user's guides for adding controllers. In short, you will be telling OptoDisplay and OptoServer which OptoControl database to open to access the communication information and strategy data items.

For more details regarding OptoDisplay and OptoServer, refer to the *OptoDisplay User's Guide* and *OptoServer User's Guide*.

UPDATING THE M4RTU/M4 I/O FIRMWARE

The M4RTU/M4 I/O consists of two processors, each running a unique real-time, event-driven operating system. The main processor contains the firmware, which executes the control strategy generated by OptoControl. The I/O processor contains the I/O firmware, which performs all of the various local I/O unit real-time tasks, such as counting, PIDs, and event/reactions. Opto 22 continues to improve the firmware by adding functionality and enhancing features.

The M4RTU/M4 I/O comes preloaded with both the current Opto 22 firmware and I/O firmware. The M4RTU/M4 I/O also comes with two disks containing the current firmware files for both Cyrano and OptoControl. The latest firmware files are also available on Opto 22's web site. Refer to Appendix G for details.

Each processor has a boot loader stored into a nondestructive part of its flash memory. This boot loader enables a user to update the firmware as Opto 22 makes new firmware files available. The firmware can be updated either locally or remotely. This enables a user to update existing firmware, change a control strategy to take advantage of a new firmware feature, and download and debug the new strategy without having to venture out to an RTU site.

If you are using OptoControl, use the OptoTerm utility, included with this controller on the OptoUtilities disks, to update the firmware. This utility can update either the main processor firmware (flash file) or the I/O processor firmware (I/O flash file). For details on using OptoTerm, consult online help or Chapter 12 in the *OptoControl User's Guide*.

If you are using Cyrano, use the Flash200 program on the disk packaged with this controller to update the firmware. For details on using Flash200, consult online help.

The boot loader for the main processor currently supports COM0, COM1, ARCNET (coaxial), and Ethernet as primary host ports for firmware updating. As new communication expansion daughter cards become available from Opto 22, new flash chips with enhanced boot loaders will be developed to support them. The new flash chips will need to be installed after removing the current flash chips located on the processor board of the base unit. Refer to Appendix E for details on this procedure.

FIELD WIRING

OVERVIEW

This chapter provides detailed information on digital and analog field wiring for the M4RTU/M4 I/O and M4RTUX. It includes examples of how to wire all currently-available G4 digital and analog I/O modules. (If a particular module is not represented, please contact Opto 22 Product Support. See Appendix G for details.)

The M4RTU/M4 I/O and M4RTUX, shown in Figures 5-1 and 5-2 on the following pages, use pluggable screw-style terminal blocks for field wiring. This type of terminal block provides users with the advantages of both a terminal block and a connector. Terminal blocks furnish a robust individual wire attachment, while connectors enable quick multi-wire disconnection. Hence, the pluggable screw-style terminal blocks provide easy installation of field wiring and easy removal of the M4RTU/M4 I/O and M4RTUX should the need arise.

A bused four-position pluggable terminal block is provided on both the M4RTU/M4 I/O and M4RTUX. This bused terminal block is located between the two field wire terminal blocks and can be used to bus user power or commons. It is not connected to any power source or ground plane on the M4RTU/M4 I/O or M4RTUX.

The terminal blocks for each unit reside under a cover, preventing removal without the use of a tool. When attaching field wiring, make sure that the M4RTU/M4 I/O is off and that field wiring is not powered, especially in hazardous environments. Field wiring should be properly prepared for terminal block installation, it should be accurately labeled, and it should be neatly dressed. Allow for adequate service loops in all field, power, and communication wiring.

If you will be connecting the M4RTU/M4 I/O to additional I/O units via the RS-485 serial link (remote), refer to the *Mistic 200 Systems Installation Guide* and the *Mistic 200 Family Data Book*.

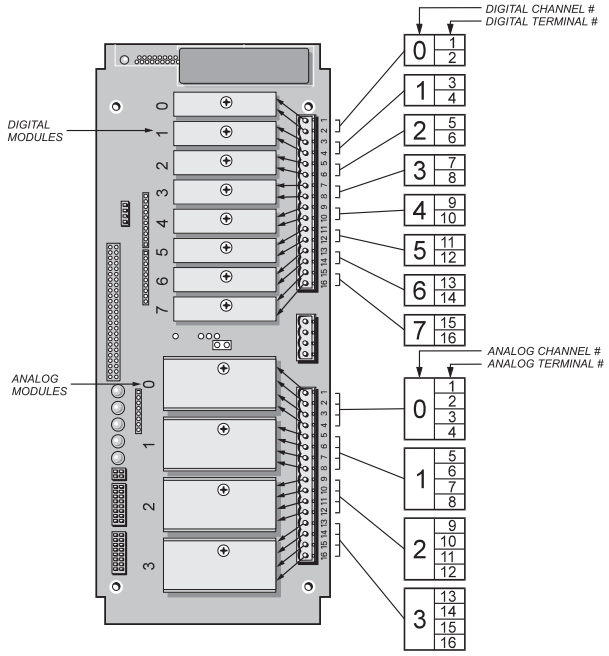


Figure 5-1: Locations of Terminals on M4RTU/M4 I/O Showing Logical Representation of Modules

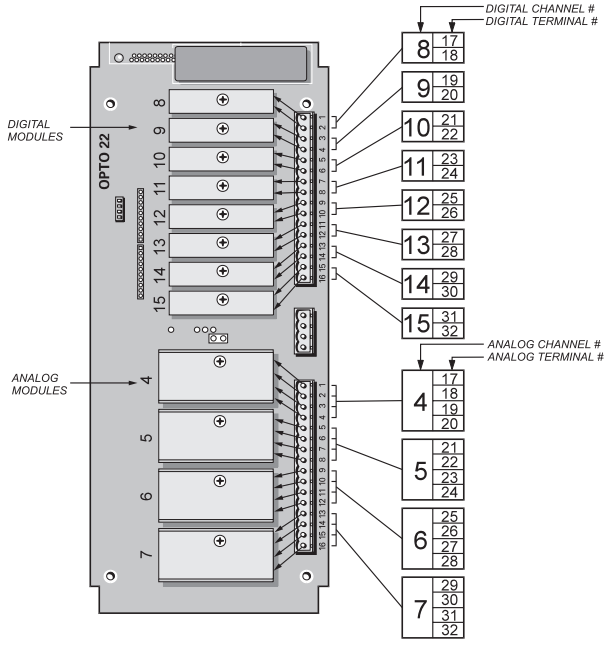


Figure 5-2: Locations of Terminals on M4RTUX Showing Logical Representation of Modules

FIELD WIRING TERMINALS

The M4RTU/M4 I/O and M4RTUX field wiring terminals are located at the top of each unit, next to their corresponding digital and analog channel locations. Together, the M4RTU/M4 I/O and M4RTUX represent a full complement of 16 digital and 8 analog channels, equivalent to the number of channels on a standard set of one digital and one analog brick. (Although the M4RTU/M4 I/O electronics can support a full complement of digital and analog channels, the unit does not have enough space to support these channels, hence the need for the M4RTUX I/O Extender.)

Note that although the I/O channels on the M4RTU/M4 I/O and the M4RTUX are labeled identically, these channels actually represent different modules logically. Hence, on the M4RTU/M4 I/O, the digital channels labeled 0–7 and the analog channels labeled 0–3 correspond correctly to digital modules 0–7 and analog modules 0–3, while on the M4RTUX, the channels with the same labels correspond logically to digital modules 8–15 and analog modules 4–7.

Each digital channel has two terminals and each analog channel has four terminals. As with the I/O channels themselves, the terminals corresponding to these channels are also labeled identically on the M4RTU/M4 I/O and M4RTUX, even though they represent different terminal connections. Hence, on the M4RTU/M4 I/O, the terminals labeled 1–16 correspond correctly to terminal connections 1–16, while on the M4RTUX, these terminals correspond logically to terminal connections 17–32.

Figures 5-1 and Figure 5-2 show the location of the digital and analog channels, as well as their corresponding terminals for both the M4RTU/M4 I/O and M4RTUX. See also Appendix F for field wiring worksheets. For additional wiring and module specification information, refer to the *Mistic 200 Systems Installation Guide* and the *Mistic 200 Family Data Book*.

CONNECTING FIELD WIRING

To connect field wiring to the M4RTU/M4 I/O and M4RTUX terminals, follow the procedures below. See Figure 5-3 for reference.

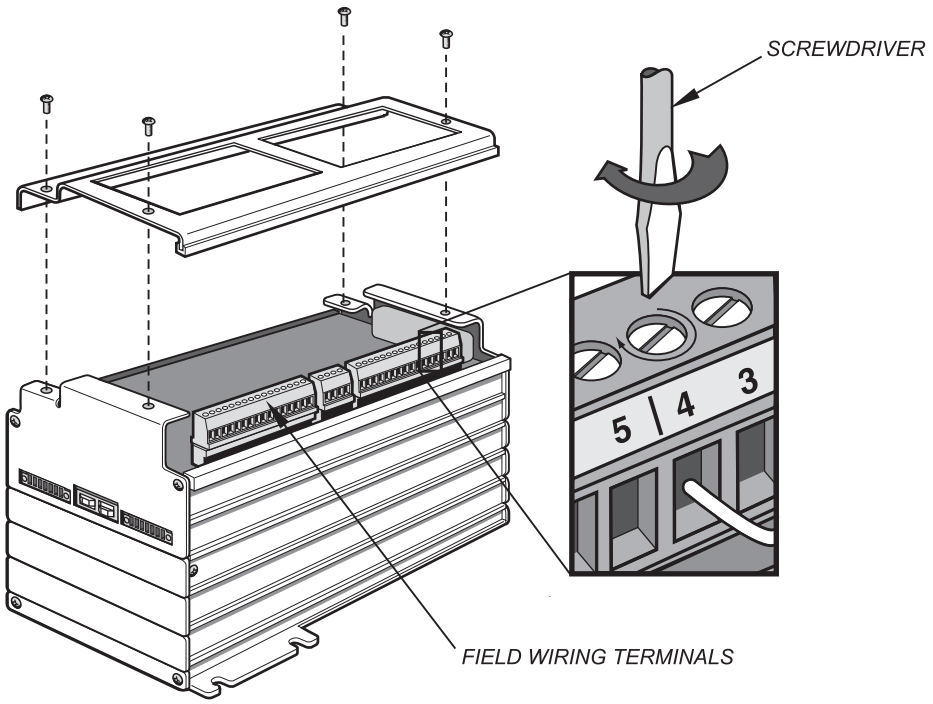


Figure 5-3: Field Wiring for the M4RTU/M4 I/O and M4RTUX

1. Access the field wiring terminals by removing the four corner screws at the top of the M4RTU/M4 I/O or M4RTUX and removing the top cover.
2. Refer to the appropriate section in this chapter for the specific model of G4 digital or analog module for which wiring will be connected. Also, refer to Appendix F for a field wiring worksheet.
3. Ensure that each terminal is completely open by turning the captive screw counterclockwise until it stops.
4. Insert each wire into the appropriate terminal block location and tighten by turning the power terminal screw clockwise. Make sure the terminal block is clamping the wire and not the insulation.

WIRING DIGITAL MODULES

Each digital I/O channel has two terminals corresponding to each installed digital module. Terminals 1 and 2 correspond to a module in channel 0, terminals 3 and 4 correspond to a module in channel 1, and so on. For polarized modules, the positive connection goes to the first terminal of the pair and the negative connection goes to the second. This wiring scheme is identical for the M4RTUX, starting with channel 8.

Input Modules

Use Figure 5-4 on the following page to wire the digital DC and AC input modules listed in Table 5-1. The diagram shows a DC input module wired to channel 0 and an AC input module wired to channel 1 on the M4RTU/M4 I/O.

For the digital input modules listed in Table 5-1, the input device may be wired to either terminal. The polarity of the power does not matter except for the G4IDC5K and G4IDC5D.

Table 5-1: DC and AC Input Modules

DC Input Modules	AC Input Modules
G4IDC5	G4IAC5
G4IDC5K	G4IAC5A
G4IDC5D	G4IAC5MA
G4IDC5B	------
G4IDC5G	------
G4IDC5MA	------

Output Modules

Use Figure 5-4 to wire the digital DC and AC output modules listed in Table 5-2. The diagram shows a DC output module wired to channel 6 and an AC output module wired to channel 7 on the M4RTU/M4 I/O.

For the digital output modules listed in Table 5-2, the load may be wired to either line.

Table 5-2: DC and AC Output Modules

DC Output Modules	AC Output Modules
G4ODC5	G4OAC5
G4ODC5A	G4OAC5A
G4ODC5MA	G4OAC5A5
G4ODC5R	G4OAC5MA
G4ODC5R5	G4OAC5AMA

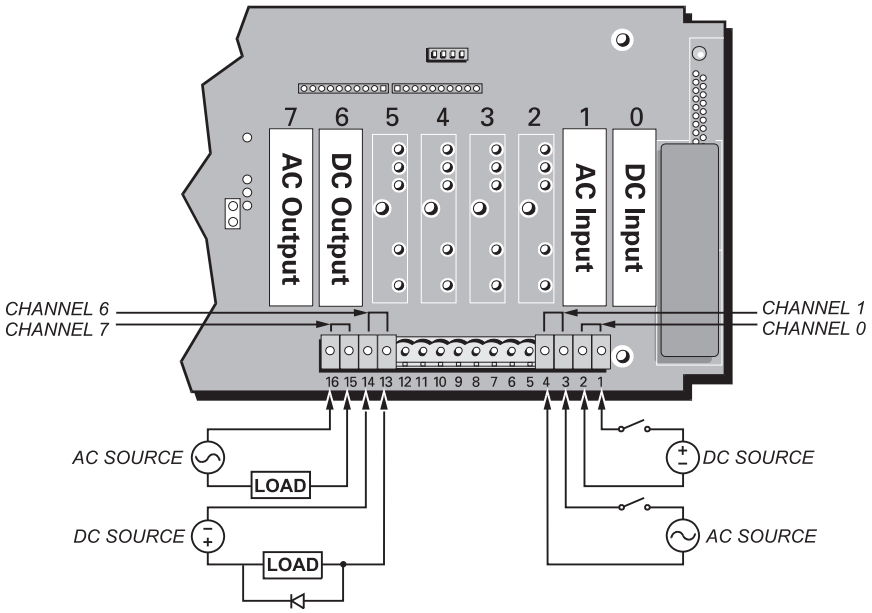


Figure 5-4: Wiring for DC and AC Input/Output Modules

For DC output modules used with inductive loads, add a commutating diode (typically a 1N4005) to the circuit as shown on the channel 6 connection to the M4RTUX.

Quadrature Input Module

Use Figure 5-5 to wire the digital quadrature input module (model G4IDC5Q). The example shows the module connected to channels 8 and 9 on the M4RTUX.

Note: *This module requires two digital channels.*

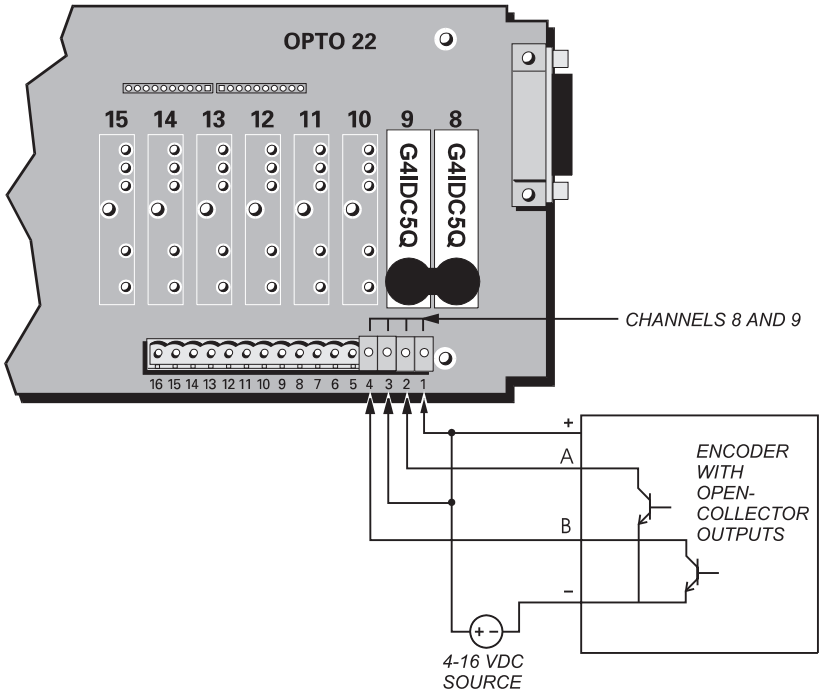


Figure 5-5: Wiring for Digital Quadrature Input Modules

WIRING ANALOG MODULES

Analog modules use up to four terminals per analog I/O channel. The following wiring diagrams illustrate field wiring schemes for each type of analog I/O module.

Voltage Input and Output Modules

Use Figure 5-6 to wire the analog voltage input or output modules listed in Table 9-3. The diagram shows a voltage input module wired to channel 0, and a voltage output module wired to channel 3 on the M4RTU/M4 I/O.

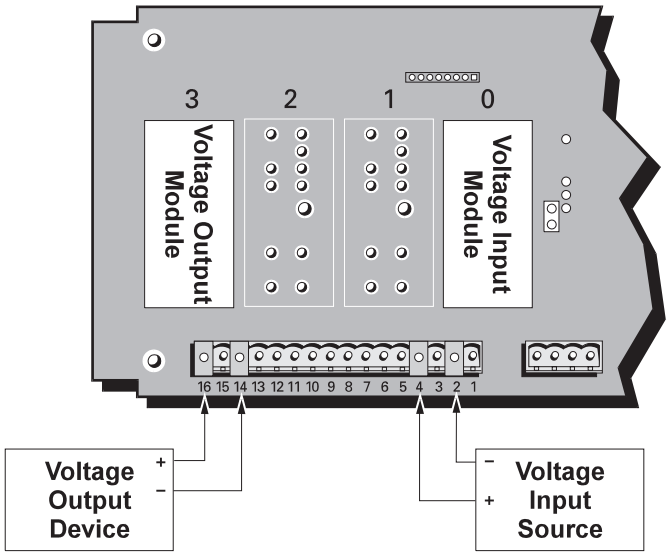


Figure 5-6: Wiring for Voltage Input and Output Modules

Table 5-3: Voltage Input and Output Modules

Analog Voltage Input Module	Analog Voltage Output Modules
G4AD6	G4DA4
G4AD6HS	G4DA5
G4AD7	G4DA6
G4AD7HS	G4DA7
G4AD9	- - -
G4AD11	- - -
G4AD12	- - -
G4AD13	- - -
G4AD22	- - -
G4AD25	- - -

Milliamp Current Input and Output Modules

Use Figure 5-7 to wire the analog milliamp current input or output modules listed in Table 5-4. The example shows wiring to the M4RTU/M4 I/O on channels 0 through 3.

The current loop for an input or output current device can be powered either by a user's external supply or by the module. Using the module reduces wiring expense.

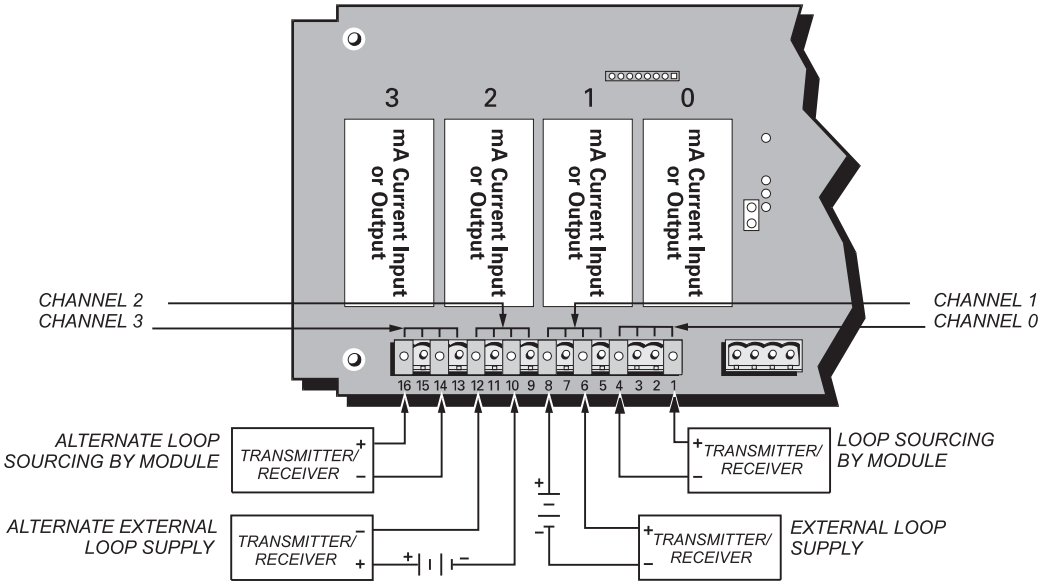


Figure 5-7: Wiring for Milliamp Current Input and Output Modules

Table 5-4: Milliamp Current Input and Output Modules

Input Modules	Analog mA Current Outputs
G4AD3	G4DA3
------	G4DA8

0 to 5 Amp AC/DC Current Input

The 0–5A AC/DC current input module can be used to measure current directly or indirectly through a standard current transformer. Applications include measuring or monitoring current through a field device such as a motor, solenoid, or lamp.

Use Figure 5-8 to wire a 0–5A AC/DC current input module (model G4AD16). The example shows wiring of the G4AD16 to channel 0 on the M4RTU/M4 I/O.

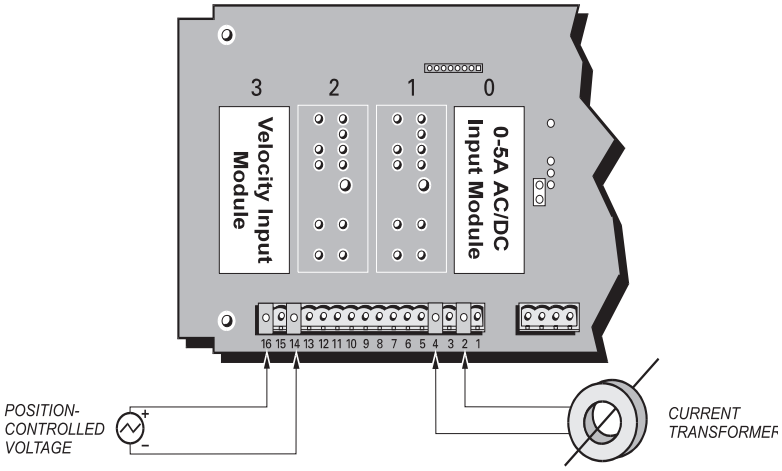


Figure 5-8: Wiring for Velocity Input and 0–5A AC/DC Input Modules

Velocity Input

The velocity input module (model G4AD26) indicates a change in voltage by providing the first derivative of voltage with respect to time (dV/dt). Typically, potentiometer-based transducers are attached. An example of an application would be a transducer measuring piston velocity in an air/hydraulic cylinder.

Use Figure 5-8 to wire the velocity input module. The example shows wiring of the G4AD26 to channel 3 on the M4RTU/M4 I/O.

Thermocouple Input

Use Figure 5-9 to wire the analog thermocouple input modules listed in Table 5-5. The example shows a thermocouple input module wired to channel 3 on the M4RTU/M4 I/O.

When wiring thermocouples, verify that you are using the proper polarity and wire color (see Table 5-5). Also ensure that the wire type from the thermocouple to field terminals is consistent and does not introduce other thermocouples.

Note: *Do not use a cold junction compensator with a G4AD24.*

ICTD Temperature Input Module

Use Figure 5-9 to wire the ICTD temperature input module (model G4AD4) to an Opto 22 ICTD probe. The example shows wiring to channel 0 on the M4RTU/M4 I/O.

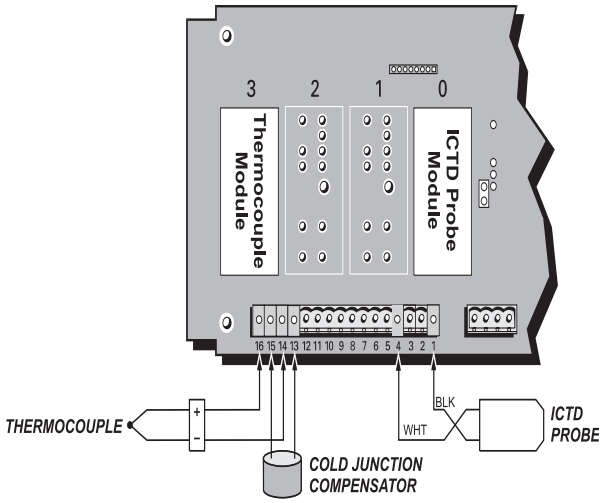


Figure 5-9: Wiring for 100-Ohm RTD Input Modules

Table 5-5: Thermocouple Input Data

Model	T/C Type	Polarity/Color	
		+	-
G4AD5	J	white	red
G4AD8	K	yellow	red
G4AD17	R	black	red
G4AD18	T	blue	red
G4AD19	E	purple	red
G4AD23	S	black	red
G4AD24	B	gray	red

100–Ohm RTD Input Module

Use Figure 5-10 to wire an analog 100-ohm RTD input module (model G4AD10). Wire colors may vary, but make sure two wires of the same color are connected as shown. The example shows a three-wire RTD probe connected to channel 4 and a two-wire RTD connected to channel 7 on the M4RTUX.

For a four-wire RTD probe, do not connect the fourth wire. Connect three wires as shown for the three-wire RTD example.

For a two-wire RTD probe, add a second wire of the same type and gauge to one end, connecting it as you would a three-wire RTD. The example shows this type of connection to channel 7 on the M4RTUX.

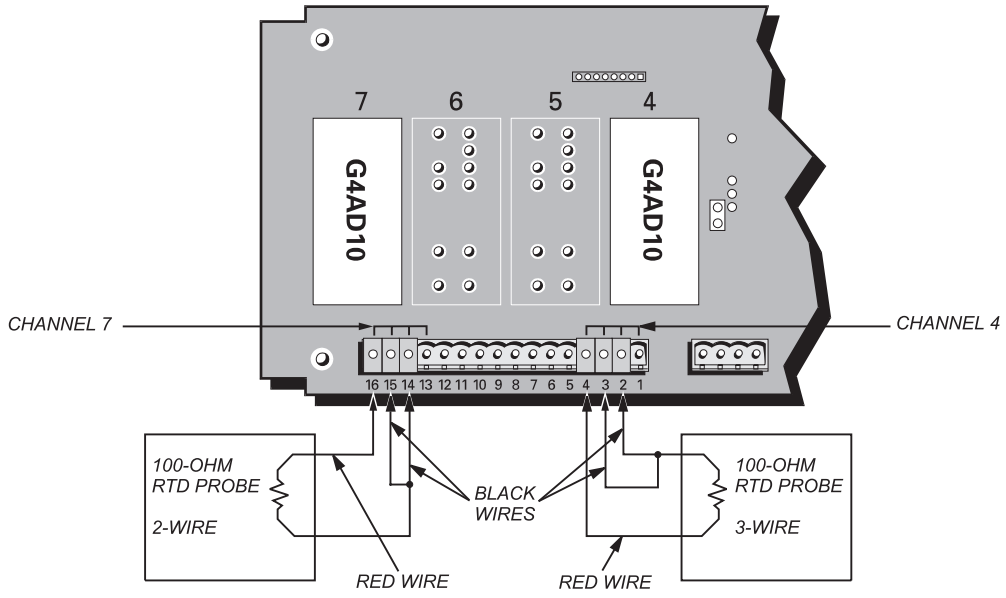


Figure 5-10: Wiring for 100-Ohm RTD Input Modules

Rate Module

The rate module (model G4AD20) measures the frequency of an incoming signal and produces a count based on the number of cycles per second (Hertz). For example, a count value of 1,000 indicates a frequency of 1,000 Hz. This module is ideal for directly reading the frequency of a signal or a rotating disk for RPM calculations, for example.

The input amplitude range from a transducer generating a square or sine wave can be changed by adding a jumper to the hookup. Refer to the wiring example connected to channel 4. The square wave input range changes from 0.5 to 24 V_{p-p} to 0.25 to 24 V_{p-p}. The sine wave input range changes from 5 to 24 V_{p-p} to 2.5 to 24 V_{p-p}.

Use Figure 5-11 as a guide to wiring the G4AD20 analog rate module. The example shows the possible wiring options to channels 4 and 7 on the M4RTUX.

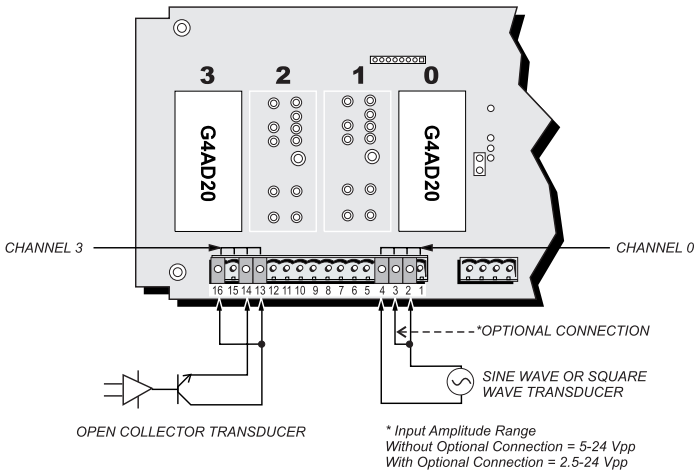


Figure 5-11: Wiring for Rate Modules

Time Proportional Output Module

The time proportional output modules switch either 5–60 VDC (G4DA9) or 12–280 VAC (G4DA10). Together with power SSRs, they are ideal for temperature control applications, such as heating.

Use Figure 5-12 to wire either of the analog time proportional output modules. The example shows a G4DA10 wired to channel 3 and a G4DA9 wired to channel 0 on the M4RTU/M4 I/O.

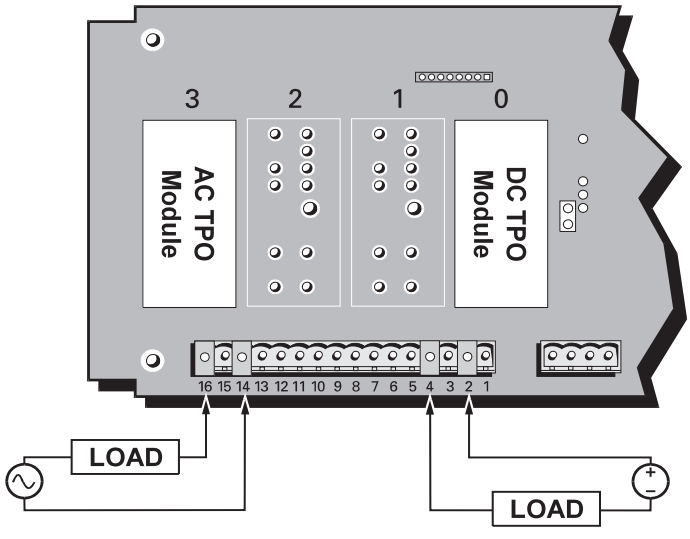


Figure 5-12: Wiring for Time Proportional Output Modules

TROUBLESHOOTING

Table A-1: M4RTU/M4 I/O Troubleshooting Chart

Indication	Condition/Problem	Action
RUN LED stays off.	Power not applied to processor.	Check power supply connections.
RUN light flashes.	Not enough power or malfunction.	Verify power supply voltage.
RUN LED flashes after a kernel (firmware) is downloaded or power failure occurred during EEPROM firmware installation.	Kernel (firmware) is corrupted.	Remove Boot Loader jumper so that M4RTU/M4 I/O boots to loader. Reinstall EEPROM firmware, then reinstall Boot Loader jumper.
TX0 (COM0 transmit) LED stays off.	Port not transmitting.	Cycle power to unit. Check CTS connection; must be connected to RTS if not used. Check jumper settings and/or controller communications setup.
RX0 (COM0 receive) LED stays off.	Port is idle. Wire or connection is bad.	Check wiring for polarity transposition. Check connections at terminals.
Host does not receive a response from the M4RTU/M4 I/O, and RX0 or RX1 (COMO or COM1 receive) LED flashes communications setup, during program download.	PC to M4RTU/M4 I/O connections are incorrect. Incorrect setup in the OptoControl controller configurations.	Check wiring connections for correct polarity and wire integrity. Check controller configurations; specifically baud rate, address, and binary/ASCII settings.
TX1 (COM1 transmit) LED stays off.	Port not transmitting.	Cycle power to unit. Check jumper settings and/or controller communications setup.
RX1 (COM1 receive) LED stays off.	Port is idle. Wire or connection is bad.	Check wiring for polarity transposition. Check connections at terminals.
M4RTU/M4 I/O controller cannot transmit to PC.	Configuration jumpers were changed without cycling power. Wiring to serial port is incorrect.	Cycle power and retry transmission. Check wiring for possible polarity transposition.
Digital output is not working.	Bad module fuse. Wrong module type. Incorrect wiring.	Replace fuse. Make sure module is 5V (G4ODC5 is correct, G4ODC24 is incorrect) Match the output module with the load. Use G4SWOUT module to troubleshoot. If G4SWOUT works, contact Opto 22 Product Support (see Appendix G).
Output does not work with G4SWOUT module installed.	Load does not work with voltage applied. Output is wired wrong.	Check field wiring worksheets (see Appendix F) and rewire, if necessary.

Table A-1: M4RTU/M4 I/O Troubleshooting Chart *(continued)*

Indication	Condition/Problem	Action
Digital input is not working.	Input device is not working properly.	Check input device wiring and power source. Rewire, replace, or fix power source as needed.
	Wrong module type.	Make sure module is 5V (for example, [G4IDC5 is correct, G4IDC24] is incorrect).
	Voltage on input is not compatible with module voltage range.	Change voltage to match module or module to match voltage.
	I/O or processor board is bad.	Use G4SWIN module and OptoControl or G4TEST to send commands to the M4RTU/M4 I/O to verify that the processor board and I/O board are working properly.
Digital input test with G4SWIN module installed.	I/O or processor board is bad.	Contact Opto 22 Product Support (see Appendix G).
Analog output is not working.	Output is wired incorrectly. Device is not properly matched to module type.	Check wiring to output device. Test module using meter and test software (OptoControl or G4TEST). Change voltage to match module or module to match voltage.
	I/O or processor board is bad.	Contact Opto 22 if meter reading does not change with value change in test software.
Analog input is not working.	Voltage output device is wired incorrectly.	Check device and wiring. Connect voltage source or current source (depending on input type) and use test software to determine if input is functioning.
	Thermocouple has a break.	For a thermocouple, check for continuity across test points next to module.
	RTD has open or incorrect wiring.	For an RTD input, check resistance across test points next to module.
	I/O or processor board is bad.	Contact Opto 22 Product Support if any of the following occurs: - If value in test software does not change with input when testing input voltage or current with test software. - If thermocouple has continuity across test points. - If resistance across test points is about 100 ohms for RTD input.

CABLE AND CONNECTOR SPECIFICATIONS

SERIAL COMMUNICATION CABLES

The following cables are recommended for both RS-232 and RS-485/422 serial communications. Although you may elect to use other cables, keep in mind that low capacitance (less than 15 pF/ft.) is important for high-speed digital communication links. The cables listed below are all 24-gauge, 7x32 stranded, with 100-ohm nominal impedance and a capacitance of 12.5 pF/ft.

Select from the following two-, three-, and four-pair cables, depending on your application needs. All will yield satisfactory results. It is recommended that you choose a cable with one more pair than your application requires. Use one of the extra wires, rather than the shield, for the common.

Two-Pair:

- Belden P/N 8102 (with overall shield)
- Belden P/N 9729 (individually shielded)
- Belden P/N 8162 (individually shielded with overall shield)
- Manhattan P/N M3475 (individually shielded with overall shield)
- Manhattan P/N M39249 (individually shielded with overall shield)

Three-Pair:

- Belden P/N 8103 (with overall shield)
- Belden P/N 9730 (individually shielded)
- Belden P/N 8163 (individually shielded with overall shield)
- Manhattan P/N M3476 (individually shielded with overall shield)
- Manhattan P/N M39250 (individually shielded with overall shield)

Four-Pair:

- Belden P/N 8104 (with overall shield)
- Belden P/N 9728 (individually shielded)
- Belden P/N 8164 (individually shielded with overall shield)
- Manhattan P/N M3477 (individually shielded with overall shield)
- Manhattan P/N M39251 (individually shielded with overall shield)

M4RTU/M4 I/O CONNECTORS

The following connectors are included with the M4RTU/M4 I/O:

Green Pluggable 7-Position Terminal Mini-Plug

- Used for RS-232 and RS-485/422 connections from the M4RTU/M4 I/O (COM0 and COM1) and the M4SSER (COM2 and COM3)
- Manufactured by Phoenix Contact (P/N MC1, 5/7-ST-3, 81)

Green Pluggable 3-Position Terminal Plug

- Used for M4RTU/M4 I/O power connection
- Manufactured by Phoenix Contact (P/N MSTB 2, 5/3-STF-5, 08)

Green Pluggable 16-Position I/O Connector

- Used for wiring from the M4RTU/M4 I/O and M4RTUX to field application hardware
- Manufactured by Phoenix Contact (P/N MVSTBR 2, 5/16-ST-5, 08)

PRODUCT SPECIFICATIONS

Table C-1: M4RTU/M4 I/O Base Unit Hardware Specifications

Item	Specification
CPU	32-bit Motorola 68020 processor 16-bit 80C196 I/O processor IEEE floating-point math
CPU clock frequency	16.67 MHz
Memory: RAM Flash EEPROM on controller Flash EEPROM on brain board	 1 MB with battery backup (user programs & data) 256 KB - 1 MB (firmware and user programs) 128 KB (I/O firmware)
RAM/clock battery	3.6-volt lithium, non-rechargeable
I/O: Base unit Extender unit Expansion	 8 digital, 4 analog, multifunction Adds 8 digital, 4 analog, multifunction Via RS-485 ports, using Opto 22 I/O
Communication: Base unit Expansion Modem support	 1 RS-232 and 1 RS-485/422 port Via daughter cards: configurable serial ports and ARCNET Direct, lease, and radio
Real-time clock	Clock/calendar, Epson 62421A with battery backup
Power requirements	5 VDC at 3.5 A (maximum) 24 VDC at 300 mA (maximum)
Typical operating temperature	-20° C to 70° C
Storage temperature	-40° C to 85° C
Humidity	5% to 95% relative humidity
Software	FactoryFloor (OptoControl, OptoDisplay, and Optoserver) Classic Software (Cyrano, Mistic MMI, and MDS)
System monitors: Host communications Watchdog timers RAM battery backup low Operating temperature	 Detect communication errors from processor, I/O, etc. Detect main power supply operation Detects program corruption (checksum RAM test) Detects temperature

ADDRESS JUMPER CONFIGURATION

The M4RTU/M4 I/O includes eight address jumpers, as described in Chapter 3. To set the jumpers based on a predetermined address, refer to the chart below.

For details on accessing and setting these jumpers, see Chapter 3.

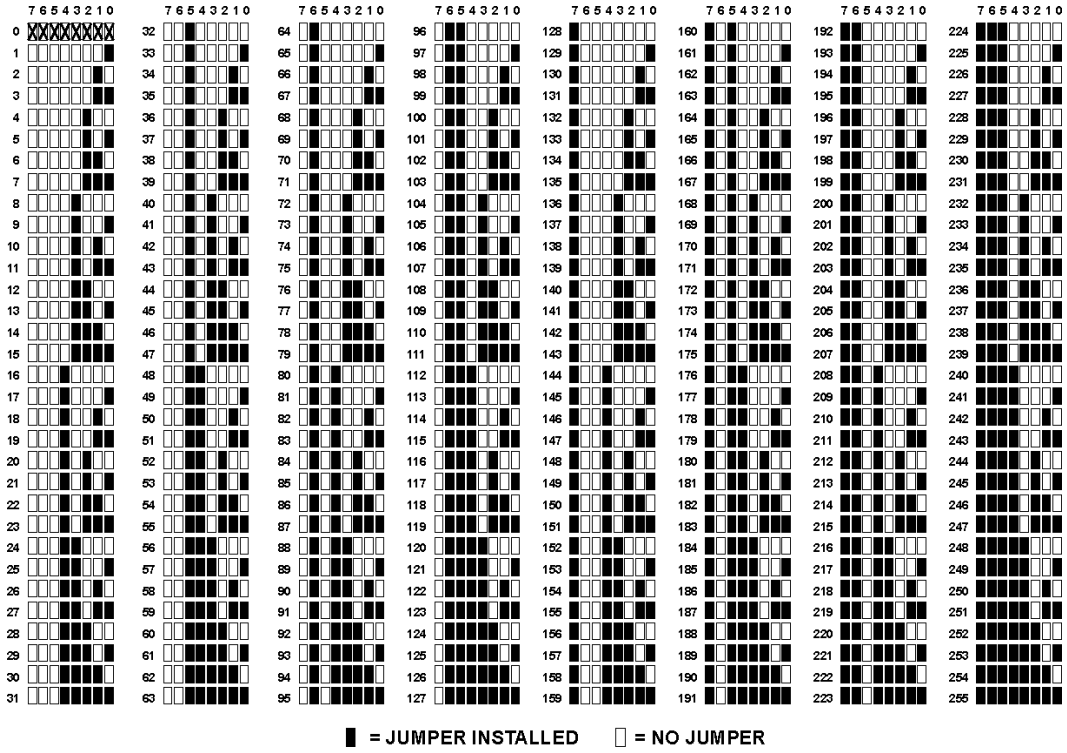


Figure D-1: M4RTU/M4 I/O Address Jumper Configurations

UPGRADING RAM AND FLASH EEPROM

OVERVIEW

If the M4RTU/M4 I/O does not have a "1 MB RAM Installed" sticker, you can expand the M4RTU/M4 I/O RAM from 256 KB to 1 MB. You can also expand the flash EEPROM from 256 KB to 1 MB. To do such an upgrade, it is necessary to remove and disassemble the M4RTU/M4 I/O base unit to access the processor board where the RAM and flash EEPROM chips are located. You can also use this process to upgrade the processor board with flash chips containing new enhanced boot loaders supporting new primary host communication hardware (e.g., fiber or Ethernet).

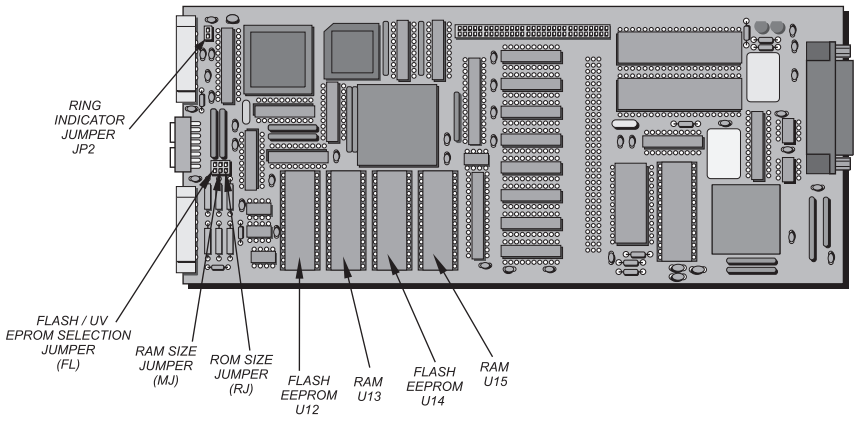


Figure E-1: Locations of Jumpers and Chips on the M4RTU/M4 I/O

To disassemble the M4RTU/M4 I/O, follow these instructions:

1. Turn off the power to the M4RTU/M4 I/O.
2. Disconnect the incoming electrical power from the power supply.
3. Remove the four screws located on the top cover of the unit. Take off the top cover. Disconnect the field wiring plug connectors.
4. Remove any communication port connectors and/or M4RTUXCAB cables.

*** Do not change this jumper.**

5. Remove the unit from its mounted position by removing the four user-supplied screw assemblies from the mounting flanges.
6. Remove the top end cap on the power supply end of the M4RTU/M4 I/O base unit by removing the two screws at the top corners of the end cap.
7. Grasp the edge of the I/O and processor boards and pull firmly until the two boards disengage from the M4BUS and slide completely out of the M4RTU/M4 I/O enclosure.
8. Gently pull the I/O board up and away from the processor board to separate the two boards. (The I/O board is parallel and on top of the processor board.) Carefully set the I/O board aside.
9. Using a chip puller, carefully remove the U13 and U15 chips for a RAM upgrade or the U12 and U14 chips for a flash EEPROM upgrade.
10. When upgrading flash EEPROM, install each chip in its correct position (U12 or U14). Each will be marked with its position. (See Figure E-1.)

When upgrading RAM, you may install either chip in either position (U13 or U15).

Note: *Ensure that the chips are correctly oriented; the notch on the chip should line up with the notch on the silk screen on the board.*

11. After correctly positioning each chip, make sure it is securely seated; however, do not attempt to force or bend the chip in place!
12. Once all chips are physically installed, set the jumpers located on the processor board to correspond to the new RAM or flash EEPROM size. See "Setting Configuration Jumpers and Switches" in Chapter 3 and refer to Table 3-2 for proper jumper settings.
13. To put the unit back together, undo steps 1–8 in reverse order.

Use Table E-1 to select RAM expansion options for your controller.

Table E-1: RAM Expansion Options

RAM Size	G4LC32		G4LC32SX		G4LC32ISA	M4RTU/M4IO/M4	
	Original[1]	New[1]	Original[2]	New[2]	_____	Original[3]	New[3]
256K	N/A	N/A	Base Configuration	Base Configuration	Base Configuration	Base configuration	N/A
512K	Base Configuration	Base Configuration	N/A	N/A	G4RAM1M	N/A	N/A
1M	G4LC32RAMEX5M	Buy 4 G4RAM1M	N/A	Buy2 G4RAM4M	G4RAM4M	G4RAM4M	Base Configuration
2M	N/A	Buy 4 G4RAM4M	N/A	N/A	Buy 4 G4RAM 4M	N/A	N/A
4M	G4LC32RAMEX4M	G4RAM4M	N/A	N/A	N/A	N/A	N/A

Use Table E-2 to select EPROM expansion options for your controller.

Table E-2: EPROM Expansion Options

Size	G4LC32		G4LC32SX		G4LC32ISA	M4RTU/ M4IO/M4
	Original	New (Flash)	Original	New (Flash)	Flash	Flash
128K	Base Configuration	N/A	Base Configuration	N/A	N/A	N/A
256K	Buy 4 27C512-120[4]	N/A	N/A	Base Configuration	Base Configuration	Base Configuration
512K	Buy 4 27C010-120[4]	Base Configuration	N/A	N/A	N/A	N/A
1M	Buy 4 27C020-120[4]	G4LC32F1M	N/A	G4LC32SXF1M	G4LC32ISAF1M	M4RTUF1M

Notes:

[1] = Chips from Intel (N/A from Opto 22). Older chips had a 256K base configuration.

[2] = See attached to determine if you have a new style G4LC32/G4LC32SX or old style G4LC32/G4LC32SX.

[3] = New controllers are marked with a "1MB RAM installed" sticker.

WORKSHEETS

The following worksheets can be used to plan I/O module installation for the M4RTU/M4 I/O base unit and M4RTUX I/O extender unit.

Worksheet Instructions

Fill in the digital or analog I/O type in the box to the right of each I/O channel shown on the worksheet. The following is an example of a completed worksheet:

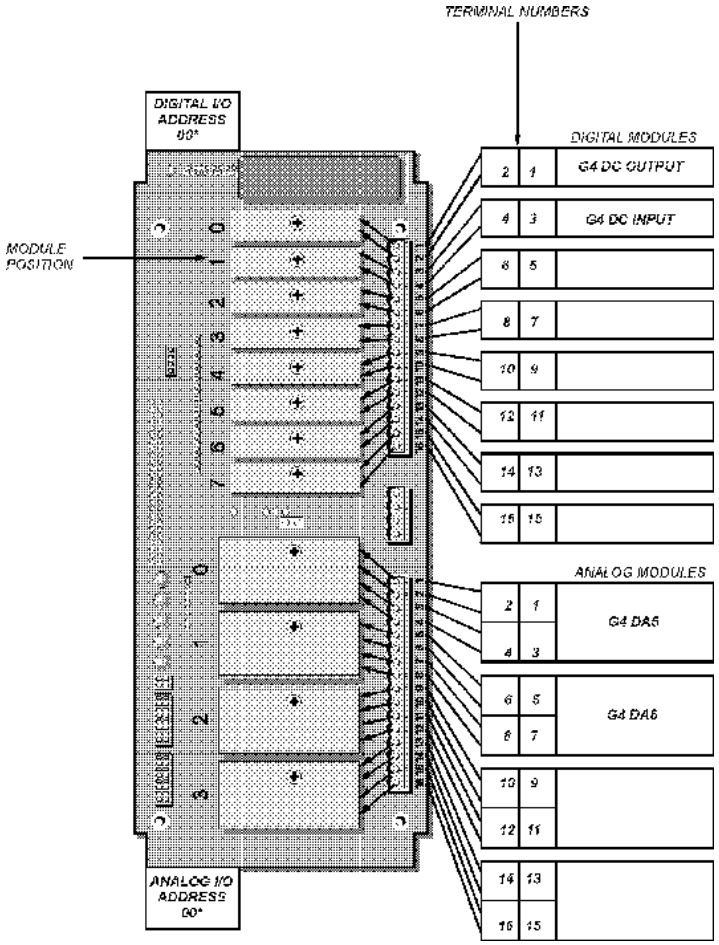


Figure F-1: Sample I/O Module Worksheet

* When configuring digital or analog I/O for the M4RTU/M4 I/O base unit using OptoControl, use these addresses and make sure the PORT type is LOCAL. See Chapter 4 (Software and Firmware) for more information.

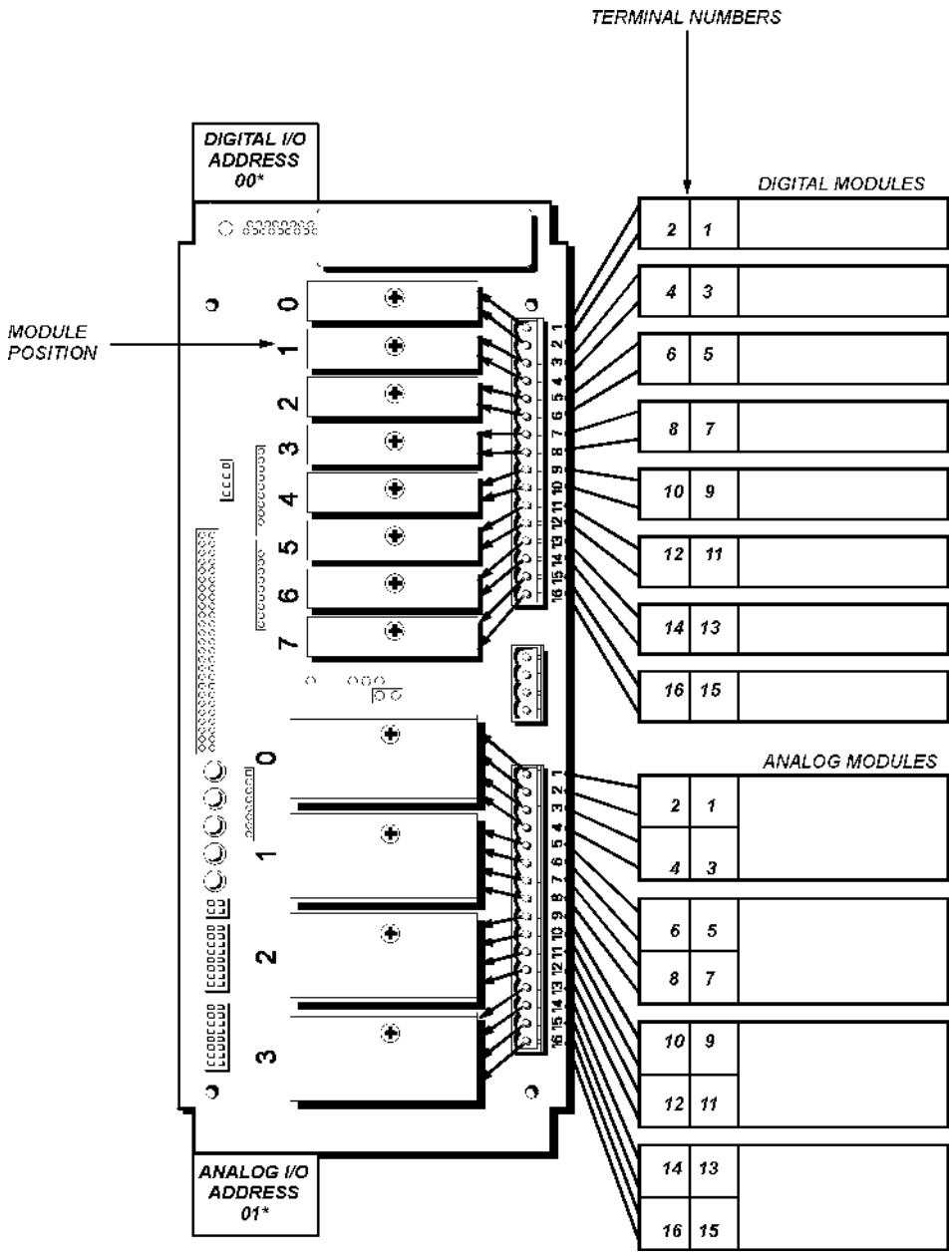


Figure F-2: M4RTU/M4 I/O Base Unit–I/O Module Worksheet

* When configuring digital or analog I/O for the M4RTU/M4 I/O base unit using OptoControl, use these addresses and make sure the PORT type is LOCAL. See Chapter 4 (Software and Firmware) for more information.

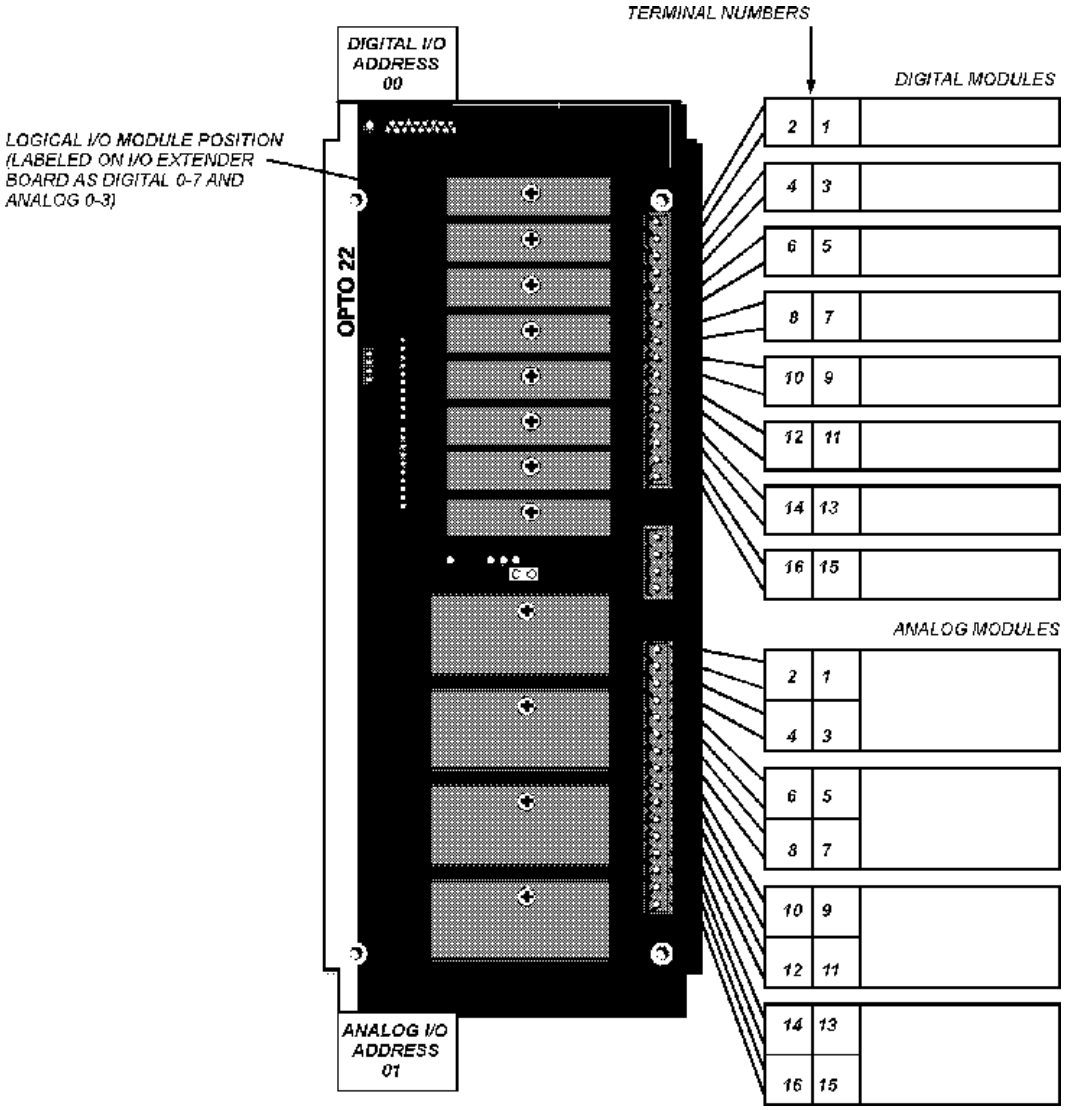


Figure F-3: M4RTUX I/O Extender–I/O Module Worksheet

FIELD WIRING WORKSHEET

The following worksheet can be used to plan and implement field wiring installation for the M4RTU/M4 I/O base unit and M4RTUX I/O Extender.

Worksheet Instructions

Fill in the wire name boxes for each terminal. The Field Wiring Worksheet can be used by your installer during RTU installation. If you need additional worksheets, make copies before filling this out.

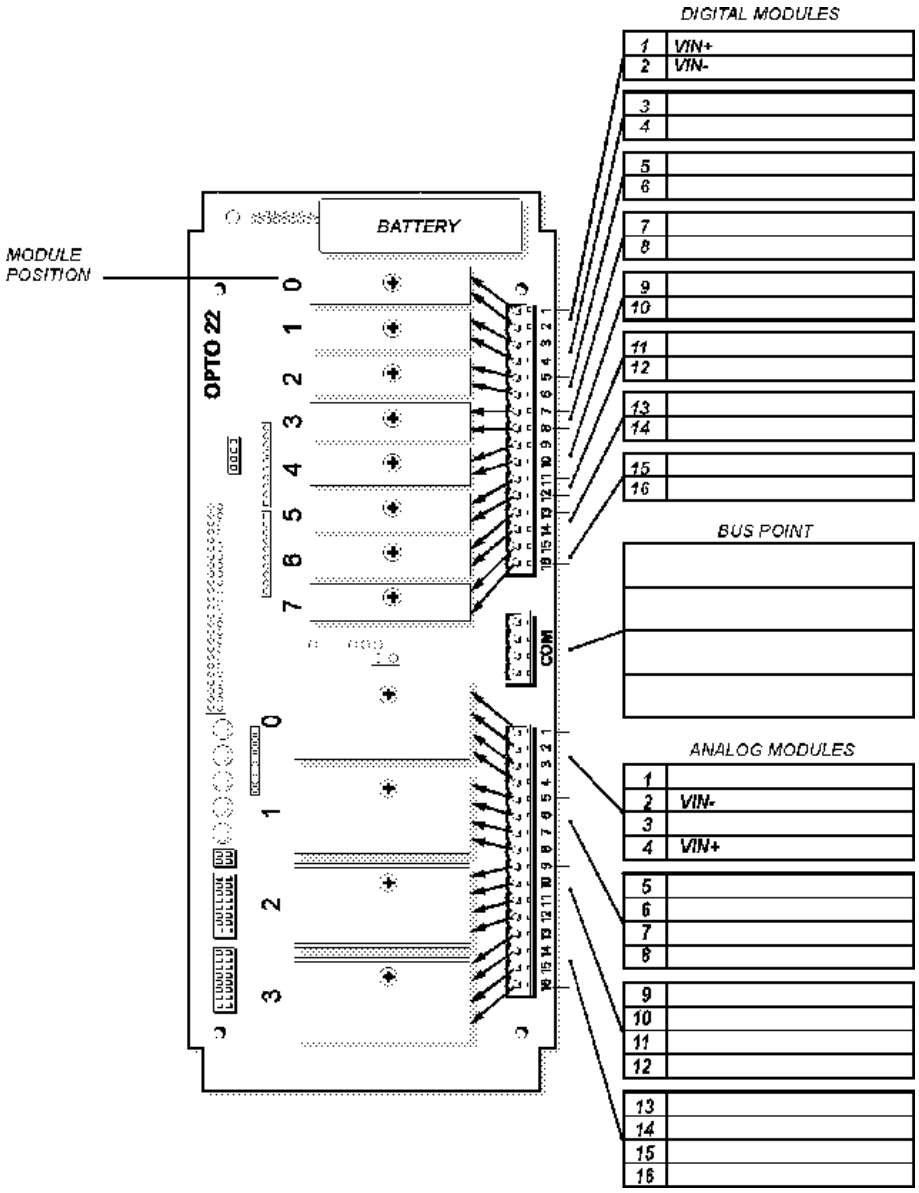


Figure F-4: Field Wiring Worksheet Example 1

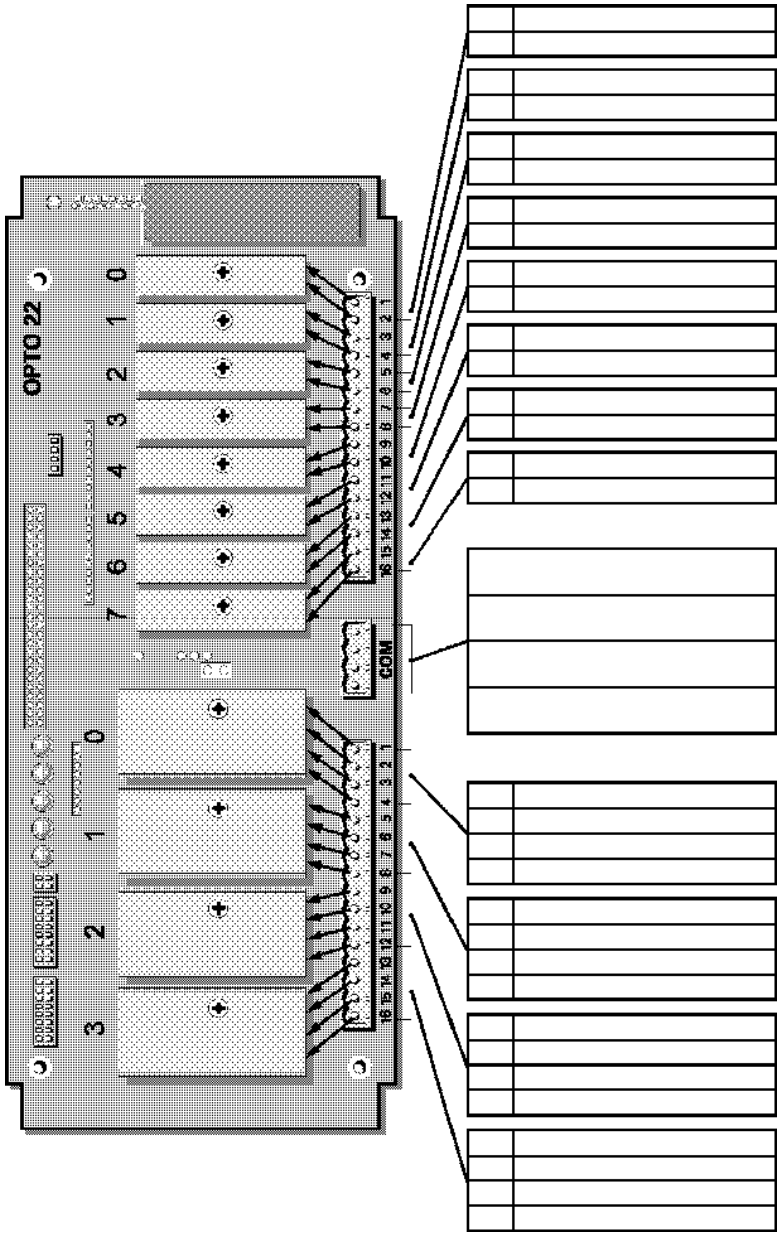


Figure F-5: Field Wiring Worksheet Example 2

Field Wiring Worksheet Examples

Hardware	Watts (W)	Quantity (Q)	Total (W x Q)
M4RTU/M4 I/O Base Unit	7.5	1.0	7.5
M4RTUX I/O Extender Unit	0		0
Daughter Cards[1]			
M4SSER	1.6		
M4SARC	1.0		
M4SARCF	1.1		
M4SARCFR	1.6		
M4SENETC	3.1		
M4SENETU	1.50		
M4DUALARC	0.7		
M4ENET100	4.1		
Digital I/O Modules:			
G4 Digital AC/DC Input/Output[2]	0.086		
G4ODC5R, G4ODC5R5	0.10		
G4IDC5Q	0.43		
Analog I/O Modules:			
G4ADX[3]	1.6		
G4AD3 Sourcing: Non-Sourcing:	 2.6 1.6		
G4DA4 Sourcing: Non-Sourcing:	 2.2 1.1		
G4DA3, G4DA8 Sourcing: Non-Sourcing:	 2.6 1.2		
G4DA9, G4DA10	0.18		
Powered RS-232 devices (e.g., barcode reader)			
Total Watts (TW):			_____W
Your supplied input voltage:			_____V
TW/Your supplied input voltage = Input Current			_____A

[1]If the daughter card you are using does not appear above, call Opto 22 for a data sheet or contact Opto 22 Product Support for wattage specifications.

[2]If the digital module you are using does not appear above, use the G4 Digital AC/DC Input Output module wattage.

[3]If the analog module you are using does not appear above, use the G4ADX wattage.

M4RTU/M4 I/O POWER CONSUMPTION WORKSHEET

Instructions

1. On the previous worksheet, locate the daughter cards and digital and/or analog modules you will be using with the M4RTU/M4 I/O. Enter a quantity for each item in the "Quantity" column. Also, fill in the quantity and wattage of any RS-232 devices on the line provided.

2 . Multiply the value in the "Watts" column by the quantity entered in the "Quantity" column and enter the result in the "Total" column for each component used.

   Example: Eight G4 digital module totals 0.688 W. Four G4ADX analog modules total 6.4 W.

3. Add the values in the "Total" column, including the value entered for the M4RTU/M4 I/O base unit, and enter the result on the "Total Watts" line.

   Example: 0.688 W (digital modules) + 6.4 W (analog modules) + 7.5 W (base RTU) = 14.588 W.

4. Enter the supplied input voltage for your installation on the "Your supplied input voltage" line.

   Example: 24 VDC.

5. Divide the total on the "Total Watts" line by the number entered on the "Your supplied input voltage" line to calculate your total input current requirements. Enter this number on the last line of the worksheet.

   Example: 14.588 W (total watts)/24 VDC (supplied input) = 0.6 A required input current for the M4RTU/M4 I/O.

PRODUCT SUPPORT

If you have any questions about this product, contact Opto 22 Product Support Monday through Friday, 8 a.m. to 5 p.m. Pacific Time.

Phone:	800-TEK-OPTO (835-6786) 951-695-3080
Fax:	951-695-3017
E-mail:	support@opto22.com
Opto 22 Web site:	www.opto22.com

When calling for technical support, be prepared to provide the following information about your system to the Product Support engineer:

- Software and version being used
- Controller firmware version
- PC configuration
- A complete description of your hardware and operating systems, including:
  — jumper configuration
  — accessories installed (such as expansion daughter cards)
  — type of power supply
  — types of I/O units installed
  — third-party devices installed (e.g., barcode readers)
- Specific error messages seen

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